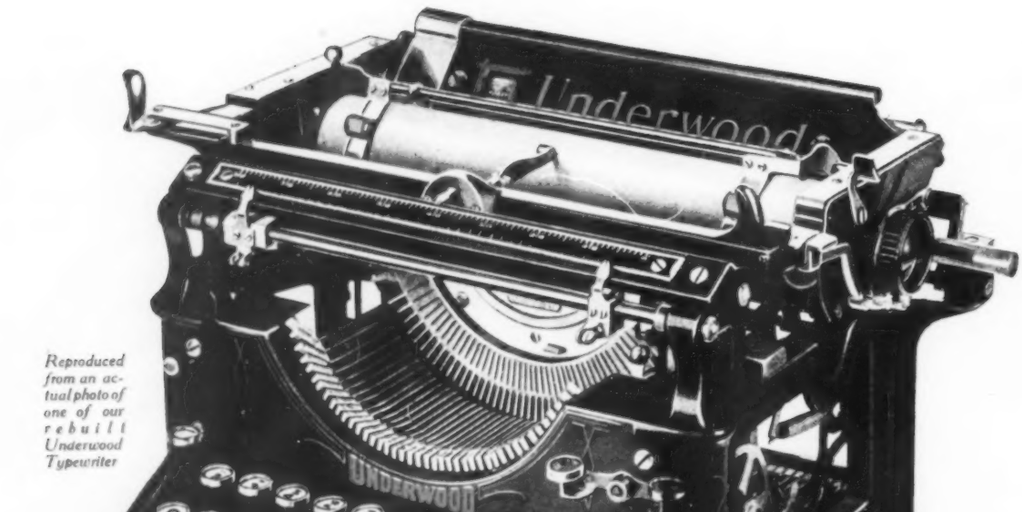
SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy MARCH 1922 $4.00 a Year

PHOTOGRAPHER SIGNALING FOR A TURN: AN INCIDENT IN AERIAL MAP MAKING.—[See page 157]

Scientific American Publishing Co., Munn & Co., New York



Reproduced from an actual photo of one of our rebuilt Underwood Typewriter

Guaranteed Five Years

$3 DOWN puts it in your home!

All shipments made direct to you from this big modern factory — the largest typewriter rebuilding plant in the world.

GUARANTEED REBUILT Shipman-Ward UNDERWOODS

YES, only $3 brings you this genuine Shipman-Ward Rebuilt Underwood direct from our factory. Then only small monthly payments makes it yours, or, if convenient pay cash. Either way, you get the world's standard typewriter, and at a big saving to you.

WHY PAY RENTAL?

Think of it! You pay only a little more each month than rental—and the machine is yours! We offer you the same four models of the Underwood Typewriter that are being made and sold by the Underwood Company today. The only difference is that Shipman-Ward machines are rebuilt like new by experts. You can't tell Shipman-Ward Rebuilts from brand new machines. Visible writing—the *full line* of typewriting is visible at all times. *Standard 4-row single shift keyboard.* Two-color ribbon, back spacer, stencil device, automatic ribbon reverse, tabulator, etc. In addition we furnish FREE water-proot cover and Special Touch Typewriting Instruction Book.

EASY PAYMENTS

You pay only a little each month. The amounts are so conveniently small that the machine will be yours before you know it. And all the time you are paying, you will be enjoying the use of and the profits from the machine.

10 DAYS' FREE TRIAL

Remember, you don't even have to buy the machine until you are fully satisfied with it after a 10 days' free trial. See for yourself how new it is and how well it writes. You must be satisfied or else the entire transaction will not cost you a single penny. And you can earn liberal cash commissions on any machine sold through you. Ask about our Agency Plan.

If you have an Underwood, we will accept it in trade for a later model or rebuild it for you. But tear out and mail the coupon now, so you will be sure to get your Underwood at a big saving. Act now—send the coupon today.

NO PAYMENTS IN JULY OR AUGUST!

FREE TRIAL COUPON

Typewriter Emporium 2183 Shipman Building,
SHIPMAN-WARD MFG. CO. CHICAGO

Please tell me, by return mail, how I can put a genuine Shipman-Ward Rebuilt Underwood in my home, for only $3 down. This is not an order and does not obligate me in any way.

☐ Send me your cash offer. ☐ Send me your easy payment offer.
(Mark with a cross)

Name .....

Street or R. F. D. No. .....

Post Office ..... State .....

Mail Coupon Today

Typewriter Emporium
SHIPMAN-WARD MFG. CO

"THE REBUILDERS OF THE UNDERWOOD" *Also Manufacturers of the Lightning Coin Changer*

2183 SHIPMAN BUILDING, CHICAGO **Established 1892**

With the Editors

NOT the least interesting phase of magazine editing is the selection and preparation of the cover subject. Perhaps it is the element of chance which makes this phase so interesting, or again it may be the natural instinct for making pictures, which is imbedded more or less deeply in all of us. At any rate, to select a suitable subject is by no means a simple matter; for when it comes to making a cover picture there are few subjects which readily lend themselves to such treatment. And even a subject that seems most suitable and attractive not infrequently proves a disappointment in the finished form. Here, then, is where the element of chance enters, which is due, in large measure, to the many steps between the inception of the idea and its realization on the printed cover. First of all, a choice is made from among a selection of subjects. Our cover artist is given the idea, together with suggestions as to composition, details and color treatment. The artist, being a rather particular sort of person, not infrequently insists on seeing the subject at first hand, and even makes his own photographs of the various details so as to ensure the utmost accuracy for his painting. For instance, in making our November cover picture, Mr. Brown, the artist, obtained his data and actually sketched his subject while riding behind the engineer in an electric locomotive. In making the present cover picture, Mr. Brown studied the airplane used in aerial photography work at first hand. The various data then take shape in a preliminary rough sketch, which is usually the object of some criticism and much suggestion. The sketch, incorporating the numerous changes and suggestions, is then transferred on to the large canvas, to be worked out in oil paint. The finished canvas, after certain slight changes which may be necessary, is sent to the lithographers in order to be reproduced. The photographer, the plate maker, the ink maker, the paper maker, the pressman—all of these are directly responsible for the carrying out of the cover idea in order that the finished result may be a success.

SEVERAL days after it became entirely clear that the Washington Conference would result in the necessity for destroying a number of American battleships, completed and under way, we had a visitor from Washington—a Naval officer. He came to tell us his troubles, and to ask us for help. This wholesale scrapping of tonnage was something new in the Navy's experience. In brief, the Navy's state of mind was, "Well, how *do* you scrap a battleship?" It was desired that we give the widest publicity to the problem, and aid the Department in gathering data. In exchange for ours we could have theirs, if we would promptly print the whole story. We investigated; the Navy investigated; others investigated. As we go to press, the answer to the problem, so far as it has been worked out, is as we give it in our handsome center insert, which is reproduced by the offset process of printing.

THIS issue is distinguished from preceding issues of the new monthly SCIENTIFIC AMERICAN by its several long articles. Always our policy is to keep our articles down to the smallest possible space, consistent with clear exposition of the subject and proper pictorial display. It just happens that several unusual subjects came along in time for this issue. "Winged Surveyors" is an interesting review of what is being done with aerial photography in these days of peace. The author is none other than Sherman Fairchild, who has done so much for this branch of photography during the past year or two. Aside from covering the technical features of his subject, Mr. Fairchild has succeeded in introducing plenty of human interest, which is always the spice of any story. Then there is the article on the scrapping of battleships, which requires four pages for proper treatment. "Radio for Everybody" is the long radio article which has been promised. It is intended as a preliminary introduction to this most timely subject, and is to be followed by other more advanced and certainly more specific articles.

WHILE on the subject of radio, we might as well announce the big radio story for the April issue. Several weeks ago various amateurs throughout the country participated in the transatlantic sending tests, and not quite thirty of the transmitters were heard in Scotland by a representative of an American radio organization. There is real romance in these tests, as well as meat for thought. The Government and the commercial stations capable of spanning the Atlantic are using upwards of 100 kilowatts for the purpose, yet along come the radio amateurs with small aerials and less than one kilowatt of energy for the same purpose. We have in mind a little shack outside of Greenwich, Conn., where a number of young men spent several long nights over their vacuum tubes and condensers, tuning coils and motor generators, sending certain code messages at predetermined times and wondering all the while if they were "getting through." But why tell the story here? This incident is only a small part of the article that will appear in the April issue.

IN view of the conference between the Government and Henry Ford with regard to the disposal and the development of the Muscle Shoals engineering project, it is well to direct attention to the article on this huge undertaking which appeared in our issue of May 7, 1921. In that issue we reviewed the engineering features of Muscle Shoals and the giant Wilson Dam, and to do so again would be but tiresome repetition. However, as Mr. Ford's plans take definite form we shall have more to say regarding this gigantic work.

JUDGING by the progress made in psychical research, as well as the steadily increasing seriousness with which such work is being greeted by the thinking people of the world, it seems but fair that a journal of this kind should at least devote a quota of its attention to the foremost developments in this latest science. In this issue, therefore, appears an article on the human aura, prepared by a member of our staff. If we had been unable to see such a phenomenon for ourselves, we should be highly skeptical. But in this article we speak from first-hand experience; and in all other similar subjects which we may treat in subsequent issues we shall make it a point to draw a very definite line between what we know, from personal experience, to be so, and what is reported to us by other persons. In some instances we shall therefore assume full responsibility for the statements made, while in others we shall make it clear that the author of the article speaks for himself, and not for us.

CONTENTS

MARCH, 1922

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN, President ORSON D. MUNN, Treasurer
ALLAN C. HOFFMAN, Secretary

EDITORIAL STAFF

J. BERNARD WALKER AUSTIN C. LESCARBOURA J. MALCOLM BIRD

DEPARTMENT EDITORS

ALBERT A. HOPKINS, Notes and Queries
ISMAR GINSBERG, Chemical Engineer.
VICTOR W. PAGE, Automotive Engineer.
HENRY NORRIS RUSSELL, Prof. of Astronomy, Princeton University.

CORRESPONDENTS

C. H. CLAUDY, Washington, D. C.
ALFRED GRADENWITZ, Berlin, Germany
HECTOR C. BYWATER, London, England
LEONARD W. MATTERS, Buenos Aires, Argentine Rep.

CORRESPONDING EDITORS

H. DIEDERICHS, Prof. of Experimental Engineering, Cornell University.
SAUL DUSHMAN, Ph.D., G. E. Research Laboratory.
EDWARD ELLERY, Consulting Chemist, Union College.
RALPH J. FOGG, Prof. of Civil Engineering, Lehigh University.
LEON A. HAUSMAN, Ph.D., Instr. in Protozoology and General Biology, Cornell Univ.
HARRY S. HOWER, Prof. of Physics, Carnegie Institute of Technology.
M. LUCKIESH, Dir. of Applied Science, Nela Research Laboratories.
ROY W. MINER, American Museum of Natural History.
H. F. MOORE, Research Prof. of Eng. Materials, Univ. of Illinois.
W. A. MURRILL, Ph.D., New York Botanical Garden.
W. C. PECKHAM, Prof. of Physics, Adelphi College.
H. C. RAMSOWER, Director of Agricul. Ext. Service, Ohio State University.
SAMUEL J. RECORD, Prof. of Forest Products, Yale University.
JOHN RITCHIE, Massachusetts Inst. of Technology.
J. HAMMOND SMITH, Prof. of Civil Engineering, Univ. of Pittsburgh.
EDWARD G. SPAULDING, Ph.D., LL.D., Prof. of Philosophy, Princeton University.
G. A. YOUNG, Head, Mechanical Engineering, Purdue University.

Vol. 126, No. 3. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MARCH, 1922

Winged Surveyors

What Aerial Photography Is Doing for Industry and Science

By Sherman M. Fairchild

"NEW YORK will be a nice place when they get it finished."

Thus spoke Tacks, one of the delightful characters of the John Henry stories, expressing his contempt for the ever-changing New York, with its torn-up streets, subway extensions, wrecked buildings and new ones taking their places, in ever-recurring cycles.

In a manner of speaking, we have never until recently had a good look at the island our thrifty Dutch ancestors bought from the Indians. As for our poor ancestors, they never did get a good look at it. In those days there were too many trees. In these days there are too many buildings.

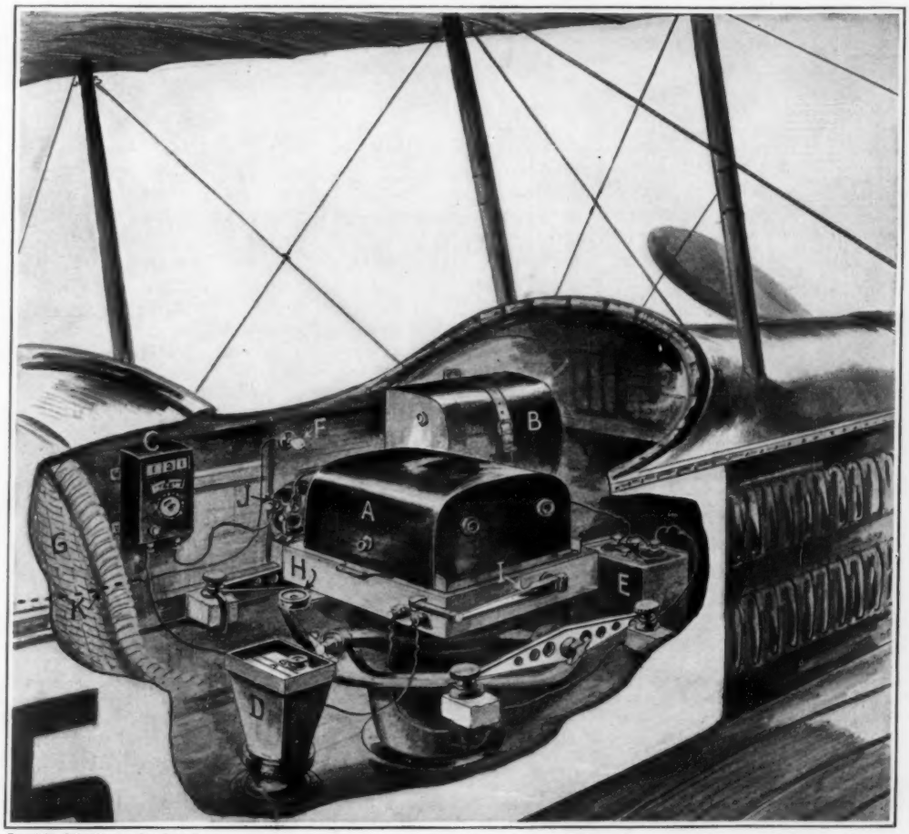
It takes an aerial view to give New Yorkers a comprehensive view of the town they live in, to make them comprehend fully the extent to which the trees have given way to the buildings, and the buildings to other buildings. And it is only recently, as remarked above, that we have been able to look down, get a bird's-eye view of the whole layout, and decide whether it was the Indians or our ancestors who drove the best bargain.

In the last six months, for example, the first complete aerial mosaic map of Manhattan Island has been assembled, and photographic prints are being made on a scale that brings out a wealth of interesting detail and opens up a vast source of information that will be useful in the further expansion of the city's commerce and industry and home building.

Oblique or Mosaic—Which?

Aerial photography of today has two distinctly separate forms as to method of production and application. There is the oblique or perspective view, which is of value in commerce and industry in diverse forms of advertising and sales field analysis. It is the most advanced method of giving a comprehensive illustration of a given area, showing in detail the character of buildings or industrial facilities of that area. The other type of photograph is the vertical or mosaic photograph, which, in its complete form, is really a series of vertical photographs taken over an area and so matched together that they form an accurate photographic map from which scaled measurements may be taken. These two phases must, in justice to the subject, be dealt with separately.

The oblique, requiring less skill and preparation, naturally preceded the vertical. Its problems, when solved, paved the way for the vertical and the development of the mosaic, from which the greatest benefits will undoubtedly be derived in the near future.



A—The camera. *B*—Extra magazine, strapped in place. *C*—Device for automatically making exposures at regular intervals. *D*—Instrument for determining the interval between exposures. *E*—Battery. *F*—Exposure signal light. *G*—Photographer's seat. *H*—Spirit level. *I*—Crank for hand operation. *J*—Motor for resetting camera. *K*—Cable to pilot's signal light

Tools of the aerial camera man, as installed in an airplane

In contrast to the war camera, the commercial camera of today is much larger and has many improvements in lens and shutter which add to the certainty of operation and the quality of the results. People often ask why it is not possible to use a kodak or graflex in the air. In principle, the aerial camera does not vary from the camera used for high-grade ground work, but the conditions under which it is used vary so much from ground conditions that a much stronger design and one more adjustable to conditions is imperative. The wind pressure, for example, is sufficient to blow in the bellows of the ground-work camera. The aerial camera overcomes this by being designed with a solid metal cone in place of the bellows.

After this comes the difficulty of vibration. The combined action of the wind and motor is such as to cause extreme vibration of anything either attached to the plane or located in the so-called "slip stream" or air puffs of the propeller. This vibration would, of course, invariably blur the picture and must be overcome.

Next comes the problem of obtaining a shutter with sufficient speed and aperture to overcome the difficulty of underexposure and give a sharp picture. The exposure must be fast, for the plane is moving at a high rate of speed, and yet sufficient light must be admitted to expose fully the negative, even though light filters be used. It has not, however, been necessary to make any provision for "stopping down" or focusing, as the lens is nearly always used wide open and is rigidly set at an infinite focus.

There have been developed several cameras in which these difficulties have been practically overcome for the purposes of taking oblique views. In one type the wind pressure is overcome by the use of the all-metal body. The plane vibration is checked by mounting the camera on sponge rubber between the shield and the camera. When the camera is so mounted in a swivel mount it can be used only over one side of the plane. This presents another difficulty, for the plane cost is usually one dollar a minute; and to economize here, two cameras are used, one over each side of the plane.

The latest development in shutters is the between-the-lens type, which is capable of making an exposure through a three-inch opening in 1/150 second. The focal-plane or curtain-and-slit variety of shutter may continue to be used largely for taking oblique photographs, but the between-the-lens shutter is coming into general use for accurate mapping work.

The negative magazine, if plates are used, is comparatively simple, being the usual type magazine used on the ground camera and holding twelve plates. When film is used, as is always the case in mapping work of the most advanced type, the magazine becomes a most intricate mechanism.

The cause of indistinct pictures can often be laid to the haze which fades out detail and outlines. Fortunately, this haze is composed of fine water particles which reflect mainly the blue light; therefore, by cutting out the blue or reflected light with yellow filters, the haze is eliminated. On ordinary plates or films the yellow filter would eliminate all the useful light, as ordinary plates and film are sensitive mainly to the blue light. Therefore, panchromatic or plates sensitive to all colors must be used. Plates can be obtained that are almost as sensitive in conjunction with filters as ordinary plates are without filters.

On the ground a photographer can take his time in selecting his viewpoint; in the air his object goes by so rapidly that it requires great skill to see the artistic view at the right moment and to operate the camera at that instant. The plane is at best an unstable tripod, and it requires great dexterity to get sharp and comprehensive pictures.

For oblique work, plate sizes vary from 4 x 5 inches to 8 x 10 inches. The most practical plate size is 5 x 7 inches, which is the largest plate that can be used without undue bulk and weight. Film is used for both oblique and mapping in 18x24 cm. or 7x9½-inch size.

The value of the oblique aerial photograph is in its value as a picture, as a permanent record of a view. It is a permanent and portable record of what the eye would see and record in the memory if the observer could remain in that spot a time of unlimited extent. The attraction of such a photograph is due to the comprehensive viewpoint and the time available to study the picture, to see all there is to see and from an angle not so very strange to us. As a picture it has greater attraction than the vertical, though compared to the vertical its value is more along advertising and pictorial than technical lines.

A New Aid to Better Advertising

The oblique has, of course, come into general use ahead of the vertical, for as stated above it requires less skill, less technical perfection, and it may be taken at almost any altitude or angle and with little if any preliminary work. The oblique view is a picture, and requires no extensive study to grasp its meaning. Starting as a novelty, it was soon discovered to have commercial uses; and in the years since the war it has been employed for advertising every type of industrial and commercial operation. New York has been the leader in adapting the aerial photograph to commercial purposes. Its chief uses have been in showing locations such as railroad and dock terminal facilities, real estate development, port development, town planning, etc. It has opened up a new method of advertising and has become an increasingly important factor in the promotion of the sale of real estate, proving its usefulness in showing the relative location of a building or site to railroad and shipping facilities, local transportation facilities and the conveniences of the immediate surroundings. It is interesting to note certain specific instances.

The Bush Terminal Company has made use of the aerial photograph to show the Bush Terminal. It has been used by the Department of Streets and Public Improvements of the City of Newark. With it, for the first time, the Jersey City Chamber of Commerce was able to illustrate the truth of the slogan, "Next to the largest city in the world," by showing its position with respect to New York City. A series of oblique views were admitted as evidence in a court investigation of high prices maintained by a public service corporation. Pictures before and after a dock fire aided the Erie Railroad in negotiating an insurance adjustment and enabled the railroad to share to a larger extent than perhaps would otherwise have been possible in the governmental circulating fund available in such cases.

Aerial photographs have been widely employed in booklets, house organs and newspaper advertising. They have been used to advertise production facilities, to promote the sale of country estates and city office, loft and factory buildings. An enterprising firm of real estate brokers and building managers equipped its salesmen with albums to aid in selling floor space in office and loft buildings. A bridge and tunnel construction company made use of an aerial photograph to show the approach to a new proposed bridge across the East River. The Amawalk Nurseries found it convenient to say what they had to say with pictures. To further a port development plan for Norfolk, Virginia, aerial pictures were used extensively by the Virginia Pilots' Association. And so it goes.

Arthur S. Tuttle, Chief Engineer of the Board of Estimate and Apportionment of New York City, is, without doubt, one of the most enthusiastic users of

Aerial mosaic map by Fairchild Aerial Camera Corp. Copyright

This small section of the aerial map of New York City represents the "toe" of Manhattan Island. Note Battery Park in the lower center. In the upper center is a dark triangle, representing the Post Office. To the left is the Woolworth Building, with its marked shadow. Above the Post Office, and slightly to the right, is City Hall Park. The wide line in the upper right-hand corner represents a part of Brooklyn Bridge. This map was made at an altitude of 10,000 feet. Obviously, reproduction in half-tone is responsible for a considerable loss of fine detail

A portion of the aerial map of New York, reproduced the actual size of the mosaic original

the aerial view. So far as we can trace, Mr. Tuttle is the first city executive to order aerial surveys for a definite purpose. A great deal of controversy between the Port authority and the Board of Estimate and Apportionment of New York City has caused both parties to utilize every possible method in order to put their plan across in the most comprehensive manner. Mr. Tuttle, being pressed for time, commissioned the aerial photographers to run a 50-mile survey over the territory where he proposed to develop new railroads connecting with the Narrows Tunnel. This survey was delivered to him within ten days of his order, seven days being spent waiting for suitable weather conditions to proceed with the work; therefore the 50-mile survey was actually flown and delivered within a period of four days. Such sections were surveyed as the Arthur Kill, showing the similar land condition both on Staten Island and Manhattan.

Copyright, Fairchild Aerial Camera Corp.

Oblique view of a portion of New York City, with the Woolworth Building very much in evidence

The second phase of the subject of aerial photography deals with the vertical photograph, the taking of which is a more complicated process, involving greater technical knowledge and skill, more preparation, and an enormous amount of work in the finishing process.

Vertical photographs look strange to us, for we are not accustomed to view things on the ground from directly above. A succession of vertical pictures taken in such a manner as to be of the same scale and made so that each individual picture overlaps other pictures, constitutes a mosaic map when assembled. Such a map is richer in information than any map made in the ordinary way. Details are evident that no surveyor could afford the time to obtain, and nothing can be overlooked or left off the map.

The story of the making of the aerial photographic mosaic of Manhattan Island is paralleled by the following account of the procedure in the mapping of Staten Island, as told by Mr. Louis MacSpadden, aerial photographer for the organization that photographed Manhattan Island from the air and assembled the vertical photographs making up the complete mosaic. The story of the vertical photograph is best told in Mr. L. MacSpadden's own words:

In the Aerial Surveyor's Own Words

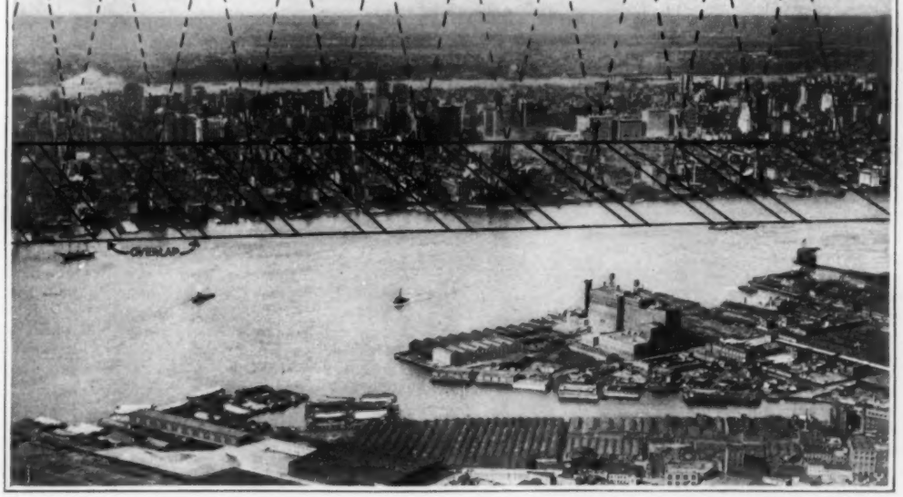
What is needed to make an aerial photographic mosaic? Can these requirements be met satisfactorily and can useful results be obtained "as is" today?

Let us consider each component of the ideal equipment to do such work today and then how each desire can be fulfilled. To be concrete, suppose it is desired to make a mosaic of Staten Island on a scale of 1/10000. The area of the island is approximately 60 square miles. Such a mosaic would show each building, large and small. Highways will stand out like a sore thumb. Automobiles can be distinguished as well as baseball diamonds—even the short cut Jones and his family use across the vacant lot is registered by the camera.

First, we start our investigation, learn what we can by study and observation, and find an aerial camera which incorporates the following specifications:

The camera is equipped with a lens of 12-inch focal length; speed of F 4.5. This means that our photographic work will be done at 10,000 feet elevation. At this altitude the air is fairly uniform; that is, not bumpy. And if the plane holds its altitude within 100 feet of 10,000 feet, our pictures will vary less than one per cent in scale.

The camera makes a picture 18 x 24 centimeters (about 7 x 9½ inches) and uses panchromatic roll film. F 4.5 lens and panchromatic film means we can use fairly heavy ray filters, and that is a good feature, as it means that we can take good pictures through a fairly thick haze. More than one hundred exposures can be made with the roll of film. An extra loaded magazine can be taken along and the magazines changed in ten seconds. Or the used roll of film can be removed and a new one put in, an operation requiring six or eight minutes. This equipment, of no particular bulk or weight, enables us to photograph a large area during a single flight.



The making of aerial maps is by no means a simple matter, since a map must be made up of a number of separate pictures. It is necessary, therefore, to lay out the mapping in such a manner that the separate exposures or pictures will overlap so that when trimmed and assembled they will form a continuous picture or map. The interval between exposures takes care of the overlap of pictures in one row, while the carefully planned flights take care of the overlapping of the rows

General scheme of exposure and overlap in the making of aerial surveys

The camera is equipped with a between-the-lens shutter of surprisingly high efficiency. Its speed can be varied from 1/50 to 1/150 of a second. This type of shutter is designed to overcome distortion which can not be overcome by the focal plane shutter. This distortion is due to the time required for the slit in the curtain of the shutter to travel across the focal plane and to the movement of the camera during this travel time, caused by "bumpy" air or vibration of the plane. Any angular movement of the camera becomes a pronounced movement of the focal axis when multiplied by a 10,000-foot radius of action.

Another feature of this camera is that it operates automatically. If the camera man finds that to obtain the desired overlap of the photographs an exposure should be made at 30-second intervals, he sets the dial on a little timing apparatus at 30 seconds. An exposure is made every 30 seconds, the shutter is tripped, the film wound ahead to the proper position for another exposure, and the shutter rewound. The distance between each exposure on the film can be set to the distance desired, and this distance will remain the same from the beginning to the end of the roll. This means that we shall get full value from the film purchased. This automatic operation is accomplished by means of a 1/20-h.p. motor operated from a storage battery.

The camera is mounted in a gimbal bearing mount, with two supports that clamp upon two strips of wood fastened to the fuselage. The supporting member rests upon special rubber supports so as to absorb high frequency vibrations.

Another necessary part of the camera equipment are two small electric lights, one to go where the pilot can see it, the other where the camera man can see it. The wiring is so arranged and connections so made in the timing apparatus that these lights are lit six seconds before each exposure is made. This warns the pilot to hold steady until the light goes out before making any necessary change in the direction of the flight. It warns the camera man to make the final leveling adjustment.

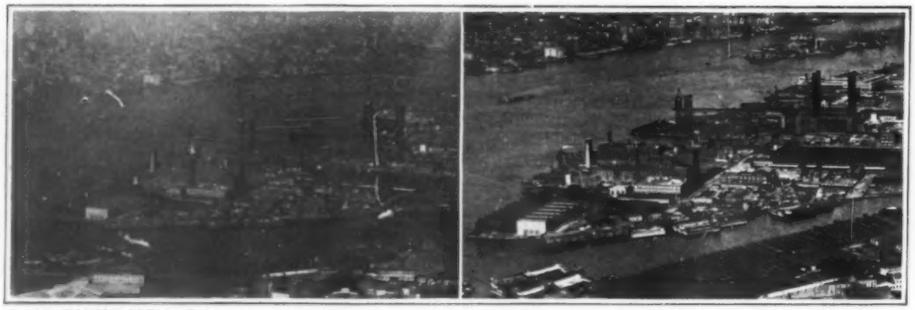
The total weight of the camera, including the motor (mounted directly on the camera), the storage battery, the timing apparatus and the mount, is 80 pounds. The whole has a neat, compact, "usable" look that gives one faith in its ability to operate as it should.

This brings us to the matter of securing an airplane.

We find a reliable flying company, operating its own flying field. The plane we decide upon as best suited to photographic use is a standard type, equipped with a 150-h.p. motor. It is not exactly the type we had pictured to ourselves, but will do the work. And the pilot is of the right sort. Flying is no wonderful, epoch-making event for him; just the day's work, and pleasant work, too.

Two strips of wood are clamped to the struts of the airplane fuselage so that they fit the camera mount. And a hole about 10 inches square is cut in the fabric covering the bottom of the fuselage, located so that the camera in the mount will take a picture of what is below through the hole.

Planning the flight necessitates getting a Staten Island quadrangle of the Geological survey. This is on a scale of 1/62500, very approximately an inch to the mile. This "representative fraction" method of specifying the scale of a map means, in the case of 1/62500, that one inch on the map represents 62500 inches on the ground. One inch to the mile means a scale of 1/63360. Our photographs are planned to be at a scale of 1/10000; one inch equals 10000 inches, or 833 feet, or 6.33 inches equals one mile. At this scale, each of our photographs will cover an area of 7500 x 5000 feet. (The true size of the negative is 18 x 22.8 centimeters, although called 18 x 24.)



Copyright, Fairchild Aerial Camera Corp.

The importance of ray filters and panchromatic plates and films is brought out in these two views, made one after the other with the same conditions. The left-hand view was made without a ray filter, while the right-hand one was made through a suitable ray filter. Note relative clearness and detail in both views, more apparent in large originals than in these miniatures

A pictorial explanation of why ray filters must be employed

Planning the Aerial Survey

In planning our photographic flight, we plan to do our work in what we believe to be the most efficient manner. All planning possible on the ground is done, while there is time to ponder. Time in the air costs a dollar a minute, and you can not have conferences with your working partner, the pilot. The motor is always roaring, and the wind washes any linguistic attempts into oblivion.

It is very important that the plane be flown over courses such that, when the pictures made are assembled, they will properly overlap, both sidewise (laterally) and fore and aft (longitudinally). The lateral overlap depends entirely on the country flown over on each photographic flight, or strip of photographs. And that is up to the pilot, who has many other duties to perform. He will be a busy person, with a head over flowing with things to be done and done right. It is necessary, therefore, to draw a line on the geological map for him to follow in the flight. This will save his resorting to memory, an impossible job, and obviate any calculating and guessing about where to fly each strip.

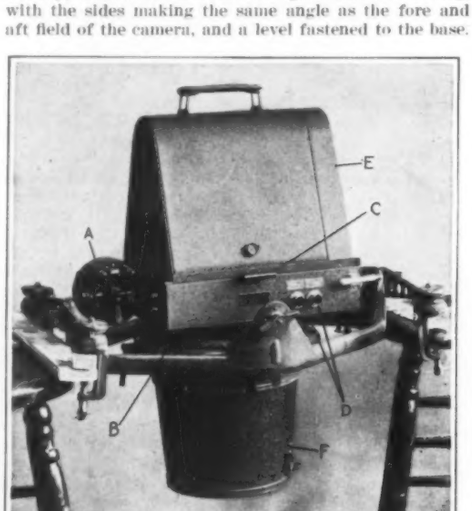
Looking at the map of Staten Island, we see that the island is a rather irregular, fat-ended egg. We plan to fly our strips lengthwise; and since we may have a cross wind and since under good conditions it is very difficult to fly a course 12 miles long exactly as planned, we will allow plenty of overlap laterally, say, 40 per cent. Then the net width of the strip will be 4500 feet; so we draw parallel lines 4500 feet apart (on the map 4500 feet is .86 inch), extending lengthwise of the island. This map is then pasted on cardboard so the pilot can handle it easily. He has only one free hand and the wind is likely to blow an unmounted map to shreds.

For the longitudinal overlap, a function of the ground speed of the plane and of the interval between exposures, we decide on 60 per cent. This may appear to be a generous overlap, but means no more flying time and is playing safe.

Sixty per cent longitudinal overlap means that an exposure should be made each time 2300 feet of ground is passed over. Our plane is rather slow speed, cruises at 60 miles per hour, or 88 feet per second. Twenty three hundred sixty divided by 88 means that in still air we should make an exposure every 27 seconds; our interval should be 27 seconds.

There will be a total of 11 photographic strips, varying in net length from a short one of two miles long on the northwest edge to the longest one of 14 miles, a total photographic distance of 75 miles. This means about 170 exposures. Allowing ample time to turn around and get set on the next strip, we calculate 100 miles flown will be the measure of the working time. At 60 miles per hour this will be 100 minutes working time. We believe that 45 minutes will give us time to reach our job and climb to 10,000 feet, and 25 minutes will be ample time to return and land, our return flight being down hill. This means a total of 170 minutes in the air, or two hours and fifty minutes to do the job. This is safely within the endurance of our plane.

When we arrive at the flying field on the day of the flight, the plane is ready on the flying line. We load our magazine, set the mount in the plane, and the camera and the batteries in the mount. We also tie an altimeter where it can be seen, meaning to satisfy our own curiosity. Also, where it can be seen and reached, we place a stop watch to determine the time interval. We also place a piece of white cardboard and a pencil handy for convenience in taking notes. Finally, we add an isosceles triangle about a foot long, with the sides making the same angle as the fore and aft field of the camera, and a level fastened to the base.



A—Driving motor. *B*—Mounting to allow camera to be turned to compensate for crabbing of the plane. *C*—Dark slide. *D*—Plug receptacles for making necessary electrical connections. *E*—Camera magazine containing the film mechanism. *F*—Shutter-speed adjustment lever

Details of the present-day aerial camera, showing the gimbal ring mounting

On the base is an inked notch marked 60 per cent, that is, 60 per cent of the length of the base from one end, which we consider the back end. This contraption is to enable us to determine the interval we should use. The spare magazine is loaded and tied in the bottom of our cockpit, the forward cockpit.

We have an understanding with the pilot that when we start on a photographic strip and reach the place where the pictures should begin, he will signal by "shaking the stick," causing the plane to fly upward and downward, slightly and frequently, or poke me with his fingers. He also signals at the end of a strip. He has the map and is on the lookout. Whenever he thinks that perhaps he is off the course, he signals to stop the camera while he circles and picks up the course again. My signaling must be done by waving a hand, to mean, "All right for that strip; now for the next," as depicted in the cover illustration, where the photographer is shown up front, and the pilot in the rear cockpit.

The mechanics start the motor and warm it up, while the pilot and I don our flying clothes. At 10,000 feet it is hardly warm, so each of us has a few sweaters, a fur-lined teddy bear, fleece-lined boots to put on over our shoes, woolen socks, a muffler, a knitted helmet that comes over the head, covers most of the face and comes down below the shoulders. There is also a soft leather face mask, with eyeholes and a small breathing hole, and a soft leather helmet and goggles.

Off for the Day's Work

We get dressed and climb into the ship. The pilot calls, "All set?" I answer, "Let's go." Then we taxi to the proper place to take off, and take off.

We make a big circle around the field and by that time have climbed to 1500 feet. It is a good day for flying, just a little haze that the K-2 filter in the lens will pierce easily. The wind is from the south, which means that the smoke from New York City is blown away from Staten Island. The light-tight safety slide is drawn from the camera and tied in the slip. The roll of film is just like rolls of film for hand cameras, in that each end of the film is attached to eight feet of light safe paper to make it daylight loading. We start the camera and make it operate 12 times, which puts the film in the exposure position. Nothing to do but see what we can see and measure our climb by the altimeter.

As we pass over the western edge of Brooklyn we reach the 10,000-foot altitude and locate the beginning of the first strip. Manhattan Island lies on our right and Coney Island on our left. The high buildings look high even from 10,000 feet, high compared to other things on the ground. It is interesting to see so much at one time; Sandy Hook and Harlem do not seem very far apart.

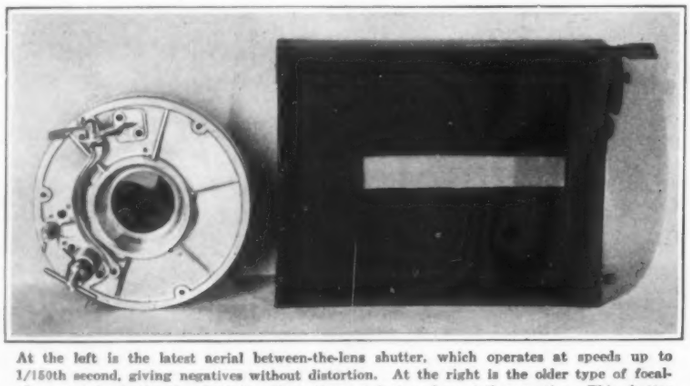
We reach the first strip extended and turn to fly the strip. First our interval must be determined. We use the triangle, holding it base down. We level the base, sight along the front leg, and, as the shore-line of Staten Island crosses this line of sight, we start the stop watch. Then sighting along the line connecting the apex of the triangle and the inked notch on the base marked 60 degrees, keeping the base level, we note when the part of the shore-line observed before crosses this new line of sight and note the time. It is 3.7 seconds. The particular point on the ground sighted moves backward, not backward and also crosswise. This means that the wind is from west to south and about 18 miles per hour. From a little table we have prepared we discover that our interval, southerly bound, is 37 seconds, and northerly bound, 21 seconds.

We signal the pilot that we are ready to start making pictures. We turn back and start. The dial on the timing apparatus is set at 37 seconds. The camera is held level and, as we approach the shore-line, the pilot pokes me and the camera is started.

The first strip, by calculation, should have taken just 15 exposures, and the camera has operated just 15 times when my back is poked. Everything lovely. We go over to the start of the second strip, the timer is set at 21-second interval, the camera leveled and exposures started. On this strip the calculated number is 20; the actual exposures 22.

We finish the job and head for home. The total time in the air is three hours and twelve minutes. The additional 22 minutes above calculated time can be laid

(*Continued on page 219*)



At the left is the latest aerial between-the-lens shutter, which operates at speeds up to 1/150th second, giving negatives without distortion. At the right is the older type of focal-plane curtain shutter, in which the slit in the curtain travels past the negative. This shutter gives rise to distortion in the negative which is especially serious in mapping work

A study in aerial camera shutters, showing the new and the old

The 1922 Car

What the New York Automobile Show Tells About the Trend of Design for the Coming Year

By J. Malcolm Bird

MORE and more, as the years pile up behind the automobile industry, we find that there exists a real consensus of engineering opinion with reference to automobile design. For some years the annual shows have tended to accentuate this; the 1922 exhibition makes it more obvious than it has ever been before. Two automobiles of the present year, whatever the names or the emblems that adorn their foreheads, are apt to be as much the same machine as two buggies or two locomotives or two electric motors of different origin. As in these parallel cases, there is sufficient difference in the details of workmanship and in the minor constructional features to insure that there shall be no dearth of talking points in favor of this, that, and the other model. But when stripped of everything that can fairly be included under the head of refinement in detail, the automobile of 1922 is, on the whole, just about the same thing mechanically, whatever the mark under which it is sold.

The Engine Itself

One conspicuous exception stands out to this statement, right at the start; yet it is an exception of degree and not of kind. When we count the cylinders, we find that instead of one consensus there are two—but that there is no question of an engineering disagreement here, that the two are intended to satisfy radically different demands. Where light weight and low cost are the features aimed at, the 1922 car is of four cylinders, and its water circulation is of the thermo-siphon type. Where weight and extreme low cost are less the deciding factors, we have the six-cylinder car, with a water pump. It is the verdict both of theory and of practice that this is the cylinder grouping that minimizes vibration and develops the greatest degree of power and smoothness, without charging the gain to gasoline consumption. Numerous sixes, in the hands of competent owner-drivers, develop twenty miles per gallon and a little more; no four can be asked to exceed this, and no eight can hope to equal it. In fact, while, as we all know, the eights and twelves comprise a goodly portion of the very highest grade cars, their makers would probably be the first to concede that they are not representative, and that they are not intended to compete with the six in operating cost.

The mythical "car of 1922" has the conventional poppet valves, of course, with a detachable L-head. As opportunity is given by the lapse of time to check up more fully on the performance of the much-vaunted overhead valve, it becomes clear that its advantages are not those of the overhead type as against the L-head type, but rather those of individual overhead-valve designs against individual L-head designs. It would not be rash to predict that the L-head will last as long as the poppet-valve does—which may not be very long, now. As for the detachable head feature, it would be a hardy designer indeed, in this year of grace, who would deny his customers access to the insides of their engines from above.

What about Poor Fuel?

Carburetion becomes more difficult every year. Eventually we shall doubtless have to redesign our carburetors to meet the progressive deterioration of our motor fuels. Pending this, every designer must consider the problem of getting the engine started, and the problem of keeping it running. On the first count, the majority of designers still force us to rely upon the priming petcock. Candor compels the admission that we can usually get the engine to run, with this; but it is sometimes pretty tough on the disposition, and even tougher on the battery. It is therefore a pleasure to record an increase in the number of cars provided with an auxiliary of some sort to insure vaporization of the fuel while the engine and the intake are stone cold. These are, naturally, for the most part of an electrical nature, though there is also the possibility, which has not been ignored, of subjecting part of the mixture to outright burning to furnish heat for the vaporization of the rest.

The necessity for some sort of pre-heating of the mixture that is fed to the hot-and-running engine is a matter of greater agreement; no car would dare come out today without at least a means of applying the exhaust heat to the intake. More complicated methods are common, too; but there is still a wide divergence as to the most profitable fashion of assisting the fuel in its vaporization. The prevention of excessive cooling is part of this theme, too; and more than twenty cars have thermostatic control, either of the radiator shutters or of a cut-out in the water line.

The Vital Spark

The electric system brings us back with a jolt to the standardization theme. All starting motors are alike, and their means of engagement and disengagement are alike; all generator-battery systems are alike; all ignition systems are alike in taking advantage of the fact that the car must carry a battery, anyhow. The additional weight and expense of providing a magneto as well would seem a small price to pay for the additional security, especially in view of the fact that the lightest and cheapest car of them all has the dual ignition. Nevertheless, it is very plain that the "car of 1922" has battery ignition, and carries no magneto in reserve.

At the front of the engine, gears are still the standard for the auxiliary drives; but their days are numbered. It is admitted that chains are quieter and that their flexibility decreases the strain on the engine. In the past they have been altogether too flexible. Chain manufacturers have been busy on this problem and now offer chain-belts of several types that will not stretch and will not leave their sprockets. No visitor to the show who looks with a seeing eye can fail to be impressed with the liberal use of chain-drive for camshafts, generators and pumps.

As regards the several driving elements, it would be almost superfluous to remark that the three-speed gearbox has driven the four-speed variety out of the United States. In the cars that have a gear-box at all, it is universal. The disk or plate clutch is fast becoming so, too; the cone is found on less than ten per cent of the models offered this year. The dry disk maintains its lead over the oil-immersed type, and will doubtless continue to do so as long as we have such admirable friction fabrics.

THE New York automobile show for 1922 is now a matter of history. In the show and out of it, there are something like 190 different makes of automobiles on the American market or about to be put thereon. In addition to the four or five new cars that occupied feature places at the show there are some 15 or 20 more that were not on the list at this time last year. Always the question that is asked at this moment is "What of the trend? Whither is automobile design headed, and how fast is it going?" Last year we replied to this question by emphasizing that the trend was emphatically in the direction of a refinement of detail. The effort to find a different answer this year makes it pretty plain that last year's answer was the correct one, and that, with the essentials standardized, our automobile designers are still searching for refinements.—THE EDITOR.

Oil and Grease

Perhaps the feature that has had most attention from our car designers during the past year has been the lubrication. It seems to be established that the average owner cannot or will not play the rôle of a machinist, and that a car that is difficult to lubricate goes unlubricated. Accordingly the old practice of using a simple splash in the pan, and demanding that the operator oil numerous other points by hand, has been going out; and today we have in a large majority of cars a combination of the force-feed and the splash which leaves the driver little to do save watch the gage. Even the grease cups have had attention, and have been reduced in number, improved in accessibility, and made subject to high-pressure greasing of some sort. The general statement seems justified that the car of 1922 requires for its complete lubrication no mechanic in overalls; that a lady in a gingham apron is quite sufficient for the job.

The Closed Car

One of the immediate consequences of the great standardization of mechanical features that has come over the industry has been that the annual shows are to a large measure reduced to body exhibits. The buyer and the seller alike take it for granted that the car will take its owner where he wants to go at the speed that pleases him and with a minimum of attention from him; and they concentrate their critical eyes upon the shape of the body, the thickness of the upholstery, the improvement in the door-latch or the window-lowering mechanism, the additional inch of accessibility gained for the gear-shift lever, the never-before-thought-of instrument on the dash, the greater number of stowage compartments. So even one who is really interested in engine and transmission, in running gear and electric system, may be pardoned the confession that the outstanding impression which he took away from New York's show this year was of the strides made in twelve months by the preference for closed cars. Doubtless the answer is largely in the fact that the closed cars of today really look like automobiles, and not like a combination of a grand-opera house and a hearse.

Even here the standardization impulse is seen. For those who want something different, there are the custom-made bodies to fall back upon; these can be had in any desired degree of eccentricity. The bodies that come on the cars, however, are so much alike that, when they are wearing their radiator covers, it is frequently almost impossible to distinguish between numerous makes. The trend toward straight lines and horizontal lines continues.

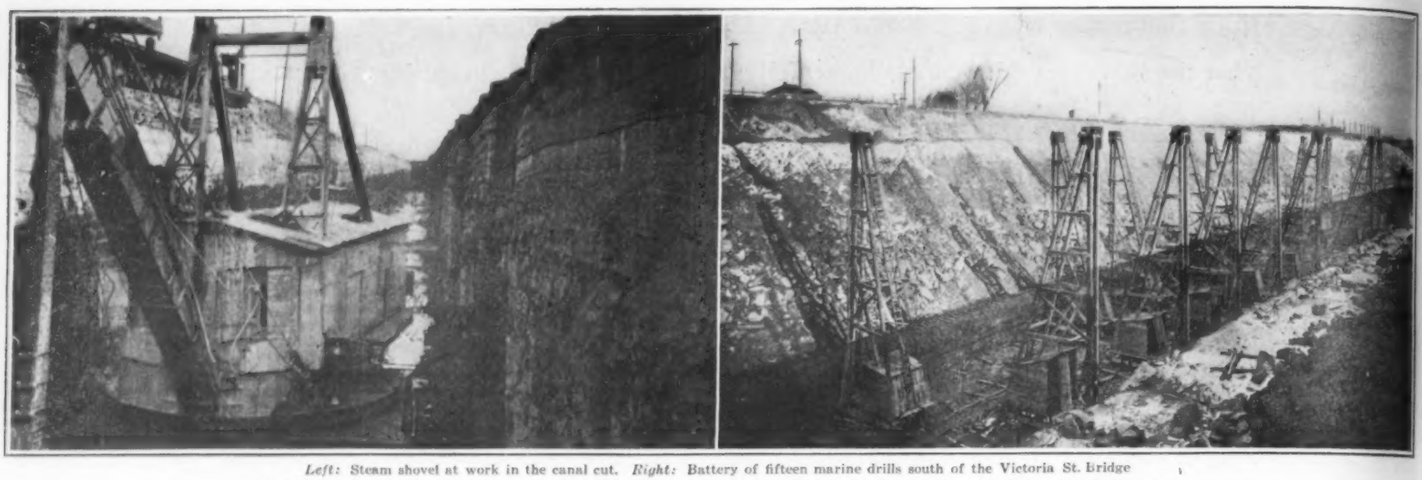
No matter what the degree of standardization in the industry at large, we shall always have with us those who deny that a thing is right simply because it is. The more the automobile becomes a cut-and-dried affair, therefore, the more the real interest in the shows will be found in the work of those makers who have the courage and the initiative to make a departure—even if it turn out to be an ill-advised one. From this point of view, the most significant feature of this year's show lies in the exhibition of four air-cooled cars in the place of the single make which monopolized this field for so many years up to 1921.

Air versus Water

We may well pause and ask "Why not?" In theory, air-cooling is just as effective as water-cooling; for in either event the ultimate cooling is by air. The water acts only as a go-between; the temperature difference which governs the issue is that which concerns the air—as every mid-summer's trip demonstrates. The advantages of air-cooling in winter time are patent and conceded; so are the joys of never having to concern one's self with a clogged radiator or a pump that does not pump. The rapid warming up of an air-cooled car, and the saving in weight, are further items on the credit side. Of what, then, do the debit entries consist?

They consist, in the first place, of an item that concerns the maker only—greater difficulty of design. The heat does not come out of the engine of its own accord; we must go in after it and bring it out. The ease with which water does this with any sort of a fairly intelligently designed jacket, the ease with which we can then expose the water in its turn to the air in any sort of a fairly intelligently designed radiator, have made it a simpler use to use water than to deal directly with the atmosphere. The mere casting of an air-cooled cylinder-array with its multiplicity of fins and flanges, is far from a simple matter. But the air-cooled car is a demonstrated success and its advantages seem well worth striving for. It would be rash to predict that the car of the future will be air-cooled; but it is very certain that many of the cars of the future will be air-cooled, and that there will be air-cooled cars in the $1500 as well as in the $3000 class.

An interesting novelty is the effort made in one of the season's new cars to reduce vibration by means of a secondary flywheel out at the front end of the crankshaft, right behind the radiator. An effort to vitalize the friction drive, doing away with the gear-box and all its complications, as well as with the clutch as we know it, appears to be of sufficient promise to justify holding it out for more extended treatment in a later issue. An ingenious item is the non-stalling engine now offered with one of the cars long standard; when the engine is about to stall, the clutch is automatically thrown out.



Left: Steam shovel at work in the canal cut. *Right:* Battery of fifteen marine drills south of the Victoria St. Bridge

Working to make the difference in level between Lakes Erie and Ontario available for power development

Moving Niagara Into Canada

The Great Power Canal That Carries the Lake Erie Waters to the Edge of the Bluff at Queenston

By J. F. Springer

THE largest hydroelectric plant now under construction is said to be that which will utilize on the Canadian side the great drop between Lakes Erie and Ontario. That drop may be considered as 330 feet. Of this, the works will actually use 305. This is greatly in excess of the difference in level at Niagara Falls. The full power development in contemplation amounts to 500,000 horsepower. Half of this is to be developed in the works now being built. The turbines have a capacity of 50,000 horsepower each. The generators are rated as 45,000 kilovolt-ampere affairs. The turbines and generators are larger than any in use elsewhere.

The generators are of the vertical type—that is, the shaft is set in a vertical position. This means that the shafts of the turbines are also vertical and that the runners rotate in a horizontal plane. A notable feature of these generators is the air system. It is altogether inclosed and so arranged that air is received from and discharged to the general atmosphere without interfering with the air inside the station. The amount of air passing in and out of a single generator is enormous. In fact, in a single day of 24 hours, the weight of air circulated amounts to eight times the weight of the generator itself. When running at full capacity, about 6,000,000 cubic feet of air are sucked in and belched forth per hour.

The power canal will receive water from two sources. The Welland River naturally debouches into the Niagara River a short distance upstream from Niagara Falls. But the final 4½ miles of the river bed are to be utilized, not to carry waters of the Welland River from west to east, but to provide a channel for waters flowing from Lake Erie and the Niagara River in an east-to-west direction. The old Welland River is in fact to terminate 4½ miles from its natural point of discharge and deliver its waters to the power canal of the hydroelectric plant under construction. The final stretch of 4½ miles of channel is being excavated to provide for a generous supply of water from four of the Great Lakes.

The power canal runs north for nearly half its length and then trends off to the northeast to reach the terminal portion of the channel through which the waters from Niagara Falls reach Lake Ontario. The junction of the water from the power canal and that from the great falls is effected at the location of the mighty powerhouse. Here the water arrives under a 305-foot head.

The fore-bay—that is, the pool or lake from which water flows directly into the penstocks—has its bottom at about 514 feet above sea-level. The surface of the fore-bay may be taken as at 550 feet elevation. The water flows through the wheels at about 245 feet elevation. Subtracting this level from that of the fore-bay surface, one obtains 305 feet for the utilized drop.

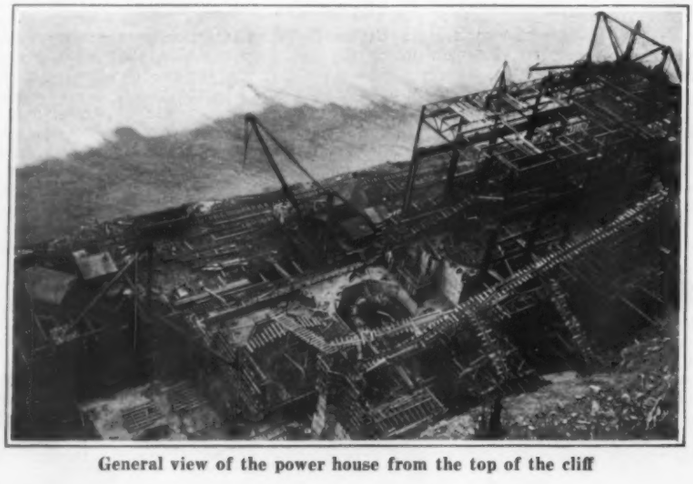
NIAGARA marks the point where nature has found an outlet for the waters of Lake Erie, but man has found it convenient to order the matter otherwise. Niagara is not to become dry; but with the completion, in late December, of the Queenston-Chippewa Power Canal much of the water which has taken this 162-foot plunge will now go over the cliff at a point where the head available for power generation will be 305 feet. Dredges have, for nearly four years, been cutting a channel through earth and rock, in a wide swing around the falls. They have taken out 13,000,000 cubic yards of earth and 4,000,000 of rock—more than the French had done at Panama when we took over the job. The SCIENTIFIC AMERICAN *has already told its readers much about this huge power project; in the present article Mr. Springer makes a final survey of the work done and of the undertaking as a whole.*
—THE EDITOR.

It is estimated that the volume of water that will pass through each penstock to drive the corresponding turbine water-wheel will, with the head at normal and the load at capacity, amount to about 1800 cubic feet per second. The control of this amount of water flowing down a steep penstock is a serious matter. Calculations showed that a diameter of about 15 feet would be required. As the penstocks were to be of steel plate and the sections had to be riveted together out in the open, this diameter was considered dangerously large for the bottom part of the penstock. The reason centered on the fact that, with so large a diameter, the plates to be riveted would have to have a thickness in excess of 1½ inches. The riveting was thought to be of too heavy a character to be carried on in the field. In consequence of this difficulty, the penstocks have been designed to have a diameter of 16 feet in the upper part and 14 feet in the lower.

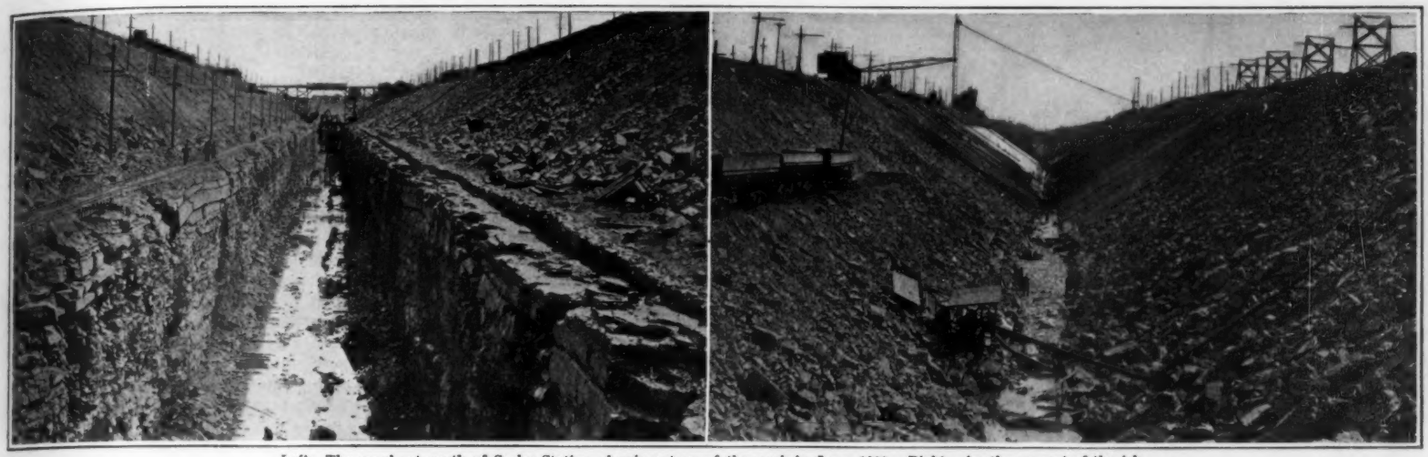
A notable feature of the plant consists in the giant control gate near the beginning of the power canal. The gate has the duty of cutting off the water supply in part or altogether. It consists of a single leaf of very large size. The width in the clear is 48 feet and the height 42½. The water back of the gate when it is down may be 40 feet or more in depth. It is said that the combination of span and head makes this gate the largest ever constructed. When the gate is lifted to maximum height, there will be 14 feet between the water level in the canal and the bottom edge of the gate. This considerable head room has been provided in order that a patrol tug may be able to pass under. This single-leaf gate will be electrically operated. Naturally, the gate is counter-weighted. This is done in pretty much the same way as in the simple and familiar case of a lower window sash. There are two main hoisting gears, which will be operated by a worm drive actuated by an electric motor.

It is thought that the design of the intake where the water from the Niagara River enters will be efficient in preventing the entrance of all ice from this source. However, it is necessary to guard against ice that may form on the surface of the power canal itself or in the Chippewa River channel. At the lower end of the fore-bay, a small ice chute is being provided. This is merely an opening through the screen house where a drop gate will be installed which may be depressed to a point 12 feet below the surface of the water. The water flowing over the gate and discharging ultimately into the river below is guided by a 10-foot, reinforced, concrete pipe.

An ice skimmer has been designed, and may be utilized later on, if found necessary. This apparatus is to skim the floating ice off the water. It has a horizontal, pivoted leaf of reinforced concrete. This leaf may be elevated or depressed at will. It may thus be adjusted to the height of the water, and when so adjusted is expected to skim off the ice as it floats along



General view of the power house from the top of the cliff



Left: The canal cut north of Scaler Station, showing stage of the work in June, 1921. *Right:* Another aspect of the job

Points at which the canal lies fairly deep below the surface of the ground

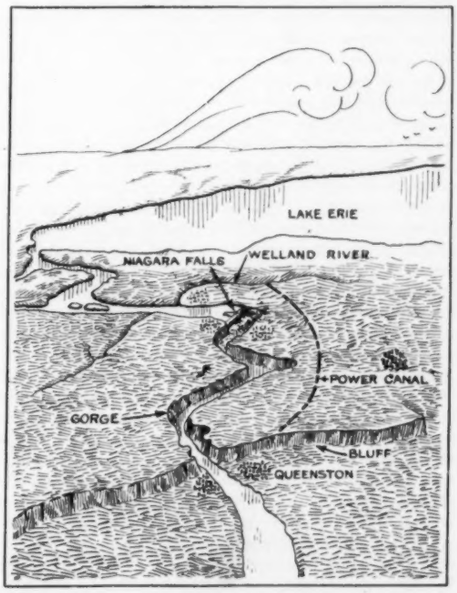
and to deliver this ice to a discharge channel, the water flowing on underneath. It is proposed to install this skimmer in a curve in the canal just above the fore-bay, in case the ice chute through the screen house has insufficient capacity to handle the ice.

Valves control the water flowing through the several penstocks. The type of valve adopted is one which is operated by means of the pressure of the water in the penstock. No external power is required. They are located at the lower end of the penstock, and this is considered an advantage.

The hydraulic turbines of record-breaking size will operate at a velocity of 187½ revolutions per minute. The maximum efficiency guaranteed is 90 per cent. This means that nine-tenths of the theoretical power will actually be developed. It is, however, expected that this efficiency will be exceeded.

That the construction work is by no means a routine job is illustrated by an interesting story connected with the "Cyclone," a big suction dredge controlled by the harbor authorities at Toronto on the northern shore of the western end of Lake Ontario. In the autumn of 1920, it was desired to bring this dredge to the head of the power canal in order that it might take part in the excavation in the first mile of the canal, where there was no rock in the prism above subgrade. The only possible route for the dredge was south across Lake Ontario and through the Welland Canal into Lake Erie; then, down Lake Erie to the Niagara River and through the 4½ miles of the old Welland River. Two great tugs were got from Cleveland and the difficult journey accomplished with their help, despite the unfavorable time of year. The last four miles of the trip lay through the Welland River and here the greatest difficulties were found. Bridges and shallow water created obstacles. The dredge itself deepened some of the shallow water, and another dredge cut away a channel for part of the distance. It was necessary to demolish in part a bridge at Chippewa. This was a temporary affair. Traffic was redirected through a railway bridge which had been out of service. When the dredge had passed the partially demolished temporary bridge, the latter was restored and the railway bridge removed. Where power electric cables were in the way, they were lifted or "killed" and the dredge permitted to go ahead in safety. Ice to the thickness of 4 or 6 inches had to be broken through ahead to provide a passage. Finally, the dredge arrived and began her part of the work of expediting the construction to the point of actual generation of power.

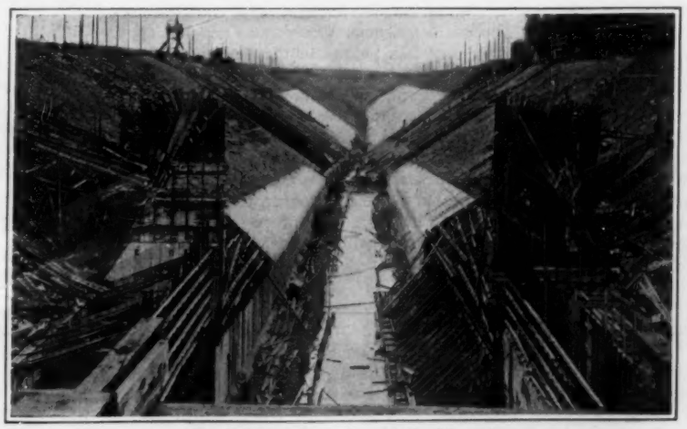
A novel method of placing concrete was adopted in recent work in the section near the famous Whirlpool of the lower Niagara River below the Falls. The side slopes of the canal trench are here very steep and also quite high. The canal is being lined with concrete through its 8½ miles of length. Here, however, the great height and steepness made the placing of concrete an exceedingly difficult piece of work. The vertical height is 54 feet and the slant height about 83. When this work was started, concrete strips a yard wide were placed parallel to one another and were run from below up. It was then necessary to fill in the intervals between strips. These intervals were about 15 feet wide: so wooden panels 16 feet long and 3 feet wide were placed lengthwise so as to cover the space between strips. These panels were held in place by means of anchor bolts embedded in the concrete of the strips. With a panel in place, the space back of it could be filled with concrete and then 3 feet of the inclined height could be covered. There was, however, so much carpenter work involved that it became desirable to adopt some other method. A big sliding form of steel was constructed. It is 16 feet long and 17 feet high. It was made of ¼-inch steel plate reinforced by channel bars. The two side channel bars were extended upward and brought together a couple of yards above the form. In this way a suitable draw bar was made. A winch was set up at the top surface and used to draw up the sliding form as desired. The concrete would be placed in the regular way for perhaps 20 feet up the slope. Then the steel form would be put in position on this concrete and the winch started. A slow upward movement was thus effected. By adjusting the upward movement of the form and the pouring of concrete in the space behind it, it has been found possible to pour some 55 feet up the slope in the space of 10 hours. The great height of the form and the slowness of the movement make it possible, under favorable conditions of weather and the like, to leave the green concrete just below the upward-moving bottom of the form in a sufficiently stiff condition to stand unprotected. It is understood that this method results in a more uniform surface and a better finish. The workmen doing the finishing really get access to the concrete while it is still green. The new method was, it seems, first suggested by the foreman, James Leith, and was then developed by the general superintendent, George Angell.



Bird's-eye view of country around Niagara, showing why there is a drop of 330 feet at Queenston, while at the point to which the Falls have now cut back there is but 162, the balance of the river's fall being in the Rapids. In this view north is at the bottom

A feature of interest concerns the mode of installing the hydraulic unit. The chief element is the runner—the wheel turned by the pressure water. This horizontal element has at the inlet a diameter of 10 feet 5 inches. This is a large, unwieldy and heavy piece of cast steel. When it is necessary to renew it because of accumulated wear, a considerable undertaking is involved. The generator is situated above; and, where the installation has been along ordinary lines, it is necessary to dismantle this large unit in order to effect the removal of the old runner and the installation of the new one. In the present power house, provision has been made for the renewal by leaving a suitable space in the foundation underneath this runner chamber so that it will be possible to take out and put in a wheel without serious disturbance of the overhead electrical unit. It is only necessary to remove a section of the draft tube underneath the runner in order to make the principal preparation.

Altogether, this new plant for the utilization of what may be called Niagara Falls waters makes an advance in the development of hydroelectric possibilities.



The Whirlpool section of the big cut

Rock Dust Poisons the Human Body

PROFESSOR COLLIS has been conducting some experiments on the effect of dust on the human body. He has shown that silica or rock dust is actually a poison on the human body. It is, of course, well known that men who work in dust are liable to tuberculosis; for instance, the South African gold miners, who are especially exposed to fine particles of quartz, and who develop what is known there as miner's phthisis; such workers are also susceptible to kidney troubles. The experiments go to show that minute fibers, which are free in the atmosphere, collect dust particles and hold them in suspension so that they are inhaled.

Our Point of View

Our Common Ancestry

GENEALOGY furnishes one of the oldest and one of the simplest of paradoxes. It is self-evident that each individual has two parents, four grandparents, eight great-grandparents, and so on by powers of two indefinitely. But if we carry the series back for thirty or forty generations, we find that each individual of the present day requires far more ancestors of this period than would be provided by the world's entire population of the date. The answer, of course, is that the lines of descent cross and mingle in inextricable confusion, so that every ancient forbear must be counted over and over again; no one can possibly guess how many tangled lines lead down to him from a single couple of the Norman period.

A consequence less frequently realized is that we are all cousins. Carry their lines of descent far enough back, and we must find that any two Caucasian individuals have many ancestors in common. This, too, is evident when once we have stated it; but few would make a sufficiently low estimate if asked how far back we might expect to go in pursuit of the common forbear, and few would realize how utterly unnecessary it is to make any reservations other than the obvious one that both subjects be the same species of Homo.

Writing in the *Scientific Monthly* for December, Dr. Jordan of Stanford University gives some details of the work done by Miss S. L. Kimball in tracing the descendants of one Isabel de Vermandois, who died in 1131. The good Isabel was married twice, both times to a husband of noble blood. She was herself descended from Charlemagne through six separate strains, and her second husband from King Alfred. The line of descent from each of her four children accordingly passes through a long series of English nobility, each allowing a younger son, a daughter or a daughter's son to drop from time to time into the middle class or even into the peasantry. Hosts of her descendants are, of course, lost so far as tracing their lineage is concerned; but the prominence of numerous lines emanating from her, combined with a series of propitious circumstances as regards many of her less distinguished offshoots, have made it possible for Miss Kimball to present a surprisingly comprehensive array of her proven descendants.

Dr. Jordan quotes a number of complete lines of descent from the Lady Isabel to persons of today and yesterday whose names mean something to us. His samples certainly justify him in quoting Miss Kimball's remark that the entire English-speaking population of the world consists of the "in-bred descendants of Charlemagne," through Isabel. Among those thus listed (the figures in parenthesis indicate the number of generations in the line of descent) are the typical colonial aristocrat George Washington (23); the most representative "commoner" of history, Abraham Lincoln (27); the leading present-day exponent of royalty, George V (27); three distinguished Americans of, apparently, wholly diverse origins in Grover Cleveland (26), Theodore Roosevelt (23), and Robert Edward Lee (20); the wife of our second President, John Adams (15), and hence his only less eminent descendants, a New England type analogous to that of Washington and Lee; a representative of the uncompromising Puritan in Jonathan Edwards (20); and, by way of including "people like you and me," Miss Kimball herself (28), and one Mr. F. E. Parr, apparently a New York State farmer, who boasts descent through 27 and 28 generations from both of Isabel's husbands, as well as another line that goes straight back through William the Conqueror and King Alfred to the Wessex kings.

By way of further demonstration that everybody is related to everybody else, the following descendants of Isabel are enumerated without full details: Nathaniel Bacon, Phillips Brooks, Edward Everett, Francis Parkman, William Ellery Channing, George Dewey, Charles W. Eliot, Ulysses S. Grant, Richard H. Dana, Benjamin Harrison, Patrick Henry, Oliver Wendell Holmes, Thomas Jefferson, J. Pierpont Morgan, John D. Rockefeller, Wendell Phillips, Nicholas Murray Butler, and Aaron Burr. Altogether, this is one of the most delightful scientific articles we have ever perused. It has in it all the human emotions—and not the least of them is the humor of the idea that we are all thus tied up with one another—notable with unknown, king with lowliest backwoodsman and peasant. There is nothing in it that we could not have imagined for ourselves, it is true; but this specific and wholesale citation of names—well, it is staggering!

The Submarine and Poison Gas

WE venture the statement that if the question of the abolition of the submarine and poison gas from warfare were submitted to the popular vote, 95 per cent of the citizens of the United States would vote that they be outlawed. The 5 per cent of our population that would vote for their retention would include those naval and military men who are concerned with the design, construction, and operation of submarines and poison gas, and with the methods of their effective use.

In drawing attention to these 5 per cent (and it is possible that it would prove to be even less than that) we have no wish to call in question the humanitarianism of the professional soldier or sailor. They have been trained to look upon the question of war, especially in these later days, from the standpoint of the strategist, the engineer, the mechanician, and the chemist, and while it is true that no body of men is possessed of a finer spirit of chivalry, or more real human kindness, than the officers of our Army and Navy, the fact remains that for them war represents fundamentally the question of how to put the largest number of men most speedily out of action, either by death, wounding, or capture.

The moral aspects of war, and of the methods of waging it, on the other hand, are more immediately a matter of national concern, and the present popular and all but universal aversion, both to poison gas and the submarine, is due to the fact that, during the late war, the people of the United States, in common with those of Great Britain, France, Italy, and all the Allied nations, took deeply to heart such horrors as the first poison gas attack on the Flanders front, and the loss of twelve hundred non-combatants on the "Lusitania" by submarine attack.

So far as poison gas is concerned, the fact that non-combatants (women, children, and aged people) can be subjected to wholesale extermination by gas attack from the air, is sufficient in itself to set a black mark against this form of warfare for all time. So far as the submarine is concerned, there is no evading the force of the argument that the late war proved it to be very inefficient against warships, but enormously efficient when used against merchant shipping. Set a ban upon the sinking of merchant ships and the submarine's occupation is gone. Judged as a naval weapon, its sole efficiency was proved in the field of scouting, particularly in watching an enemy's ports and harbors. Except in this regard, one hundred thousand tons put into submarines does not begin to compare with an equal tonnage put into surface vessels.

Poison gas and the submarine have not been abolished as yet, but a great step has been taken in the Washington conferences in placing stringent restrictions upon the methods of their use. We are confident that the good work thus begun will be consummated in future conferences by the complete abolition of both these forms of attack.

The Automatic Stop Made Obligatory

THE Interstate Commerce Commission in issuing a sweeping order directing forty-nine railroad systems to equip certain congested sections of their main lines with automatic train control devices has acted in the same spirit which led the government many years ago to enforce the use, on all freight trains, of both the Janney coupler and the automatic brake.

As one of the earliest advocates of the use of the automatic stop, the SCIENTIFIC AMERICAN congratulates the Interstate Commerce Commission on the judgment which it has shown in issuing this order; for the automatic stop is the last logical step in a system for the prevention of collisions, which, commencing with the semaphore, has developed through the block signal (first hand-operated, and then electrically-operated) to the present device, which eliminates the human element, and thus removes an all-too-frequent cause of collisions.

The report states that the investigation by its special train council committee has demonstrated to the satisfaction of the Commission that automatic train-stop devices are practicable. "Our investigations have shown," says the report, "that automatic train control has long since passed the experimental stage. In fact, no safety devices such as the automatic coupler, the air-brake, and the automatic block signal, were perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted." We are told that, after fourteen years of investigation and study, the service tests under varying conditions, and the results obtained in the actual employment of this device over periods of years, have clearly demonstrated the practicability of and the necessity for automatic train-stop control. Hence, it is considered that the time has arrived when the railroads should be required to select and install such devices as will meet the specifications and requirements of the Commission. For the reason that the Commission does not wish to discourage efforts to automatically control trains without the aid of fixed wayside signals, the installation of the automatic stop will not be limited to roads which are already equipped with automatic block signals. It is believed that it is possible to apply train-stop or train-control devices often where automatic block signals are not in use.

As a further protection to the traveling public (to say nothing of valuable freight), the importance of this order can scarcely be overestimated, for it cuts out the possibility of accident through failure of the human element. Faulty vision, carelessness, or sudden physical collapse of the engineer can no longer produce such disastrous collisions as occur too frequently, even in this age of automatic block signaling and improved train and track equipment. (It is well within the resources of the mechanical and the electrical engineer to produce automatic equipment which will absolutely prevent collisions, provided it is maintained at all times in first-class working condition. Proof of this is to be found in the New York subway system, where for many years past express trains running at forty to forty-five miles an hour, under a headway of from one and a half to two minutes, have carried over a billion of passengers without the loss of a single life through collision.)

It is true that certain automatic stop systems are, or rather were, subject to disablement in storms of snow or sleet; but we understand that there are certain mechanical devices which have completely overcome their winter troubles. Furthermore, one or more systems have been developed in which electrically controlled apparatus on the locomotive is affected inductively by a signal circuit at the track side.

Can Change of Proportions Ever Constitute Invention?

IN a recent decision involving a patent for a metallic alloy, a Federal Court of Appeals has held that while the proportions of the various metals were slightly different from those theretofore employed, there was no evidence to show that the change in proportions had produced any new result. The patent was therefore declared void; but there was a strong intimation that had there been evidence of the sort suggested, the decision might have been different. As indicating

Our Point of View

what might have turned the scales, the court cited among other cases the one commonly known as the Minerals Separation Case, wherein the United States Supreme Court sustained a patent for a method which differed from a prior and long-used method only in that there was employed in the process an amount of oil specifically less than one per cent.

There was considerable evidence in this *cause celebré* to show the greater effectiveness of the process carried on with less than one per cent of oil, as against the old process where oil slightly in excess of this percentage was employed. But regardless of this, is it not questionable whether one who merely changes the proportions of known ingredients or agents can be said to have exercised the inventive faculty? Suppose a mining engineer, using an old process and seeking to produce a better operation and improved results, experiments by altering the proportions of certain substances employed in the process. Even if his efforts be highly successful, is it conceivable that he has done anything more than was expected of him in view of his education and experience in the particular work in hand?

Or let us assume that the housewife embarks upon the baking of bread. She follows a recipe which calls for the mixing of flour, water, milk, yeast, shortening; she puts these together as instructed, and gets the oven at the designated temperature, and confides her mixture thereto; and as a result of all this she produces bread. But she is not satisfied and she starts a series of experiments to see whether she can not get a better result. She does not change the ingredients in any way. She merely alters the proportions—a little less milk, a little more shortening, perhaps. In time she produces in this way what she regards as a satisfactory loaf of bread. Has she made an invention?

We do not believe that any court would so hold. The method of attack upon her problem used by our housewife, as by our mining engineer and our metallurgist, bars any claim to true invention. She may have succeeded in getting from the flour more of the nutritive value; it may be she is the first to do this; in the proportions hit upon by her the chemical reactions of rising and baking may be materially different from what they familiarly have been. Yet we can not concede that she is an inventor.

The engineer and the metallurgist who produce new and better results by a change in proportions have done nothing more in their fields than the housewife in hers. With all due respect to the courts in their decisions outlined above, we can not see that anyone who simply varies the proportions of known ingredients in carrying out an old method or in the production of an old alloy can possibly be conceived as having made an invention —no matter how startling the consequences of the alteration in formula which he has made. We well know, for instance, that in the Minerals Separation case the new proportions employed by the patent which was upheld are such as to lead to a process of "flotation" altogether different in theory from that involved in previous separation by oil. But the mere chance unfolding of an unsuspected chapter of natural law by an experiment which any one at all versed in the art might fairly have been expected to try is not, in our mind, invention. Discovery it is, yes; the anticipated discovery of the inventor, never.

We think also that we are justified in applying this reasoning to mechanical construction. Can it ever be said that changing the size and proportions of parts of a machine, even though the machine be extraordinarily improved thereby, involves invention? Would one who takes a child's perambulator and makes it large enough so that it can be used as a horse-drawn vehicle be an inventor? We can see no difference in what all these parties have done. If such patents are sustained it will result in letting down the bars which now separate the realm of patentable invention from that of ordinary mechanical skill, and in materially cheapening the efforts of real inventors.

Airplane Endurance

DID it ever occur to you that endurance, or the ability to remain continuously in the air, is by all odds the most important qualification in the average airplane? We are, of course, well aware that there are special types, such as racing machines, in which long endurance is a secondary consideration; but for the average commercial machine a wide radius of action—the ability to leave the ground and stay in the air hour after hour, independently of landing grounds, fuel supply, and repair men—is the prime consideration.

A machine like the all-metal monoplane, which recently brought the world's endurance record to this country, is to be credited with something more than a brilliant flight in the field of competitive sport. Looked at in its broadest aspect, the fact that this little machine, with two men, went up in a snowstorm, remained aloft throughout a night marked by severe cold and a gale of wind, and came to earth after between twenty-six and twenty-seven hours of continuous flying, proves that it is possible to build an airplane today which compares in reliability with the long-established means of transportation. When the art has been developed to the point where any standard make of airplane can be depended upon to show the same reliability as this monoplane; commercial air travel will increase by leaps and bounds. We are inclined to think that the uncertainty of flying, with its forced descents involving too often fatal accidents, has been the most serious hindrance to the rapid development of airship travel.

Manufacturers of airplanes should encourage flights of long duration such as this. No stronger testimony to the excellence of a machine and its motor can be afforded than a flight of twenty-four hours or more duration, attested by recognized officials.

The rapid rise of the automobile in public confidence and estimation was largely due to the long-distance races in the early years of the development of the art. A machine that could pass through the gruelling test of a 500-mile race, at speeds of from seventy to one hundred miles per hour, left upon the public mind the conviction that the automobile had passed from the experimental to the thoroughly practical stage. This assurance was strengthened by the various transcontinental and other long-distance trips which were achieved at about the same period.

The story of the development of the airplane in respect of its ability to stay in the air continuously, is contained within a period of fifteen years. The official records of duration start in 1906 when Santos Dumont remained in the air for 21 seconds, at Bagatelle, France, in a 50-h.p. Santos Dumont machine. In 1907 Henry Farman lifted the record to 52 seconds, in a 40-h.p. Voisin machine. Then in 1908 Wilbur Wright, in a 24-h.p. Wright machine, made a flight of 1 hour, 31 minutes and 53 seconds, and later in the year raised the record to 2 hours, 30 minutes and 23 seconds. In 1909 Farman, in a 50-h.p. machine of his own make, remained aloft for 4 hours, 17 minutes and 53 seconds, a record which he nearly doubled in the following year with a duration flight of 8 hours, 12 minutes and 23 seconds. In 1911, with one of his 70-h.p. machines, he set the record at 13 hours, 17 minutes and 57 seconds. Little was done in the way of duration flights until 1914, when the 100-h.p. Mercedes engine proved its reliability by maintaining a Roland machine, piloted by Langer, in the air for 14 hours and 7 minutes, and in the same year Boehm, in a 100-h.p. Albatross, brought the record beyond the full-day limit with a flight of 24 hours and 12 minutes.

During the war nothing was done in the way of duration flights, but in 1920 a Farman Goliath machine, driven by two 260-h.p. Salmson motor engines, achieved a duration flight of 24 hours 19 minutes and 7 seconds. This has now been exceeded by the record of our own Edward Stinson, who has improved upon the European record of 1920 by the handsome margin of 2 hours and 28 seconds. In a comparison of the machines, it should be noted that whereas the Farman Goliath machine was equipped with engines of 520 combined horsepower, a single 135-h.p. N.M.W. motor sufficed for the trim little Larsen monoplane.

Are Railroad Cars Too Heavy?

FOR many years past we have been watching with no little interest the steady increase in the size and weight of rolling stock. This increase has taken place in agreement with the well-proved fact that, broadly speaking, the larger the individual unit for the transportation of freight and passengers, the more cheaply can they be carried. This is true both of the steamship and of the railroad car; but it is recognized among steamship men that, because of problems of operation which are peculiar to a steamship of enormous size such as the "Leviathan," there is a limit to which increase of dimensions can profitably be carried. So true is this that it is generally agreed that not for many years to come, if ever, will another "Leviathan" be built.

Now, we are inclined to think that the time has arrived when the railroad man should ask himself whether he has not reached, or indeed exceeded, the limit of size and weight in freight and passenger cars, with coal cars of 120 tons capacity, and Pullman cars that are about 90 feet in length and approximately as many tons in weight.

We are well aware that great size of the individual unit has always been a marked characteristic of our American railroads, and that this is due both to the geography of the country, with its vast distances to be covered, and to the demand of the American people for increased comfort, particularly in transcontinental journeys. We are not now, however, contesting the reasonableness of the demand for great size and weight in our rolling stock, but we do wish to put the question up to the practical railroad man whether in meeting these conditions we have not in, let us say, our 90-foot Pullman car gone a little too far.

The Pullman car is a 90-foot bridge structure carried upon end piers or supports represented by the two trucks. Now the weight of a bridge may be said to increase, roughly, as the square of its length, and it can readily be seen that, as between a train made up of 60-foot cars and one made up of 90-foot cars, there would be a very large saving of dead-weight in favor of the short-car train. In answer to the statement that the weight of a Pullman car makes for greater ease of riding, it is sufficient to say that, although this was true in the days of light rails and indifferent roadbeds, it has but little weight in these days of 100-pound steel rail, and track with eighteen inches of stone ballast.

As to the other fallacy that the great weight of the Pullman of today is conducive to safety, it may fairly be answered that, considered by themselves, superfluous weight and momentum are positive elements of danger in collision. It would be possible to build your lighter 60-foot car with as much relative strength to resist the effects of collision, as is shown by the ponderous 90-foot car. As a matter of fact, a given number of passengers carried in a 60-foot car train of Pullmans would be subject to less danger in the event of derailment or collisions than the same number if carried in 90-foot cars, the inertia of the train being considerably lighter and the destructive effects less. Of course, we are supposing that in both cases the cars are built of steel, and upon approved methods of construction. Additional saving would be effected by substitution of four-wheeled for six-wheeled trucks.

Then there is the question of upkeep of tracks and bridges. The lighter concentration of weight on the four-wheeled trucks would be less severe on the track: the impact at rail joints would be less, and the bridge engineer would find that he could lighten out the floor system of his bridges to no little extent. We offer the above suggestions with an invitation to their discussion.

Our Point of View

Our Common Ancestry

GENEALOGY furnishes one of the oldest and one of the simplest of paradoxes. It is self-evident that each individual has two parents, four grandparents, eight great-grandparents, and so on by powers of two indefinitely. But if we carry the series back for thirty or forty generations, we find that each individual of the present day requires far more ancestors of this period than would be provided by the world's entire population of the date. The answer, of course, is that the lines of descent cross and mingle in inextricable confusion, so that every ancient forbear must be counted over and over again; no one can possibly guess how many tangled lines lead down to him from a single couple of the Norman period.

A consequence less frequently realized is that we are all cousins. Carry their lines of descent far enough back, and we must find that any two Caucasian individuals have many ancestors in common. This, too, is evident when once we have stated it; but few would make a sufficiently low estimate if asked how far back we might expect to go in pursuit of the common forbear, and few would realize how utterly unnecessary it is to make any reservations other than the obvious one that both subjects be the same species of Homo.

Writing in the *Scientific Monthly* for December, Dr. Jordan of Stanford University gives some details of the work done by Miss S. L. Kimball in tracing the descendants of one Isabel de Vermandois, who died in 1131. The good Isabel was married twice, both times to a husband of noble blood. She was herself descended from Charlemagne through six separate strains, and her second husband from King Alfred. The line of descent from each of her four children accordingly passes through a long series of English nobility, each allowing a younger son, a daughter or a daughter's son to drop from time to time into the middle class or even into the peasantry. Hosts of her descendants are, of course, lost so far as tracing their lineage is concerned; but the prominence of numerous lines emanating from her, combined with a series of propitious circumstances as regards many of her less distinguished offshoots, have made it possible for Miss Kimball to present a surprisingly comprehensive array of her proven descendants.

Dr. Jordan quotes a number of complete lines of descent from the Lady Isabel to persons of today and yesterday whose names mean something to us. His samples certainly justify him in quoting Miss Kimball's remark that the entire English-speaking population of the world consists of the "in-bred descendants of Charlemagne," through Isabel. Among those thus listed (the figures in parenthesis indicate the number of generations in the line of descent) are the typical colonial aristocrat George Washington (23); the most representative "commoner" of history, Abraham Lincoln (27); the leading present-day exponent of royalty, George V (27); three distinguished Americans of, apparently, wholly diverse origins in Grover Cleveland (26), Theodore Roosevelt (23), and Robert Edward Lee (20); the wife of our second President, John Adams (15), and hence his only less eminent descendants, a New England type analogous to that of Washington and Lee; a representative of the uncompromising Puritan in Jonathan Edwards (20); and, by way of including "people like you and me," Miss Kimball herself (28), and one Mr. F. E. Parr, apparently a New York State farmer, who boasts descent through 27 and 28 generations from both of Isabel's husbands, as well as another line that goes straight back through William the Conqueror and King Alfred to the Wessex kings.

By way of further demonstration that everybody is related to everybody else, the following descendants of Isabel are enumerated without full details: Nathaniel Bacon, Phillips Brooks, Edward Everett, Francis Parkman, William Ellery Channing, George Dewey, Charles W. Eliot, Ulysses S. Grant, Richard H. Dana, Benjamin Harrison, Patrick Henry, Oliver Wendell Holmes, Thomas Jefferson, J. Pierpont Morgan, John D. Rockefeller, Wendell Phillips, Nicholas Murray Butler, and Aaron Burr. Altogether, this is one of the most delightful scientific articles we have ever perused. It has in it all the human emotions—and not the least of them is the humor of the idea that we are all thus tied up with one another—notable with unknown, king with lowliest backwoodsman and peasant. There is nothing in it that we could not have imagined for ourselves, it is true; but this specific and wholesale citation of names—well, it is staggering!

The Submarine and Poison Gas

WE venture the statement that if the question of the abolition of the submarine and poison gas from warfare were submitted to the popular vote, 95 per cent of the citizens of the United States would vote that they be outlawed. The 5 per cent of our population that would vote for their retention would include those naval and military men who are concerned with the design, construction, and operation of submarines and poison gas, and with the methods of their effective use.

In drawing attention to these 5 per cent (and it is possible that it would prove to be even less than that) we have no wish to call in question the humanitarianism of the professional soldier or sailor. They have been trained to look upon the question of war, especially in these later days, from the standpoint of the strategist, the engineer, the mechanician, and the chemist, and while it is true that no body of men is possessed of a finer spirit of chivalry, or more real human kindness, than the officers of our Army and Navy, the fact remains that for them war represents fundamentally the question of how to put the largest number of men most speedily out of action, either by death, wounding, or capture.

The moral aspects of war, and of the methods of waging it, on the other hand, are more immediately a matter of national concern, and the present popular and all but universal aversion, both to poison gas and the submarine, is due to the fact that, during the late war, the people of the United States, in common with those of Great Britain, France, Italy, and all the Allied nations, took deeply to heart such horrors as the first poison gas attack on the Flanders front, and the loss of twelve hundred non-combatants on the "Lusitania" by submarine attack.

So far as poison gas is concerned, the fact that non-combatants (women, children, and aged people) can be subjected to wholesale extermination by gas attack from the air, is sufficient in itself to set a black mark against this form of warfare for all time. So far as the submarine is concerned, there is no evading the force of the argument that the late war proved it to be very inefficient against warships, but enormously efficient when used against merchant shipping. Set a ban upon the sinking of merchant ships and the submarine's occupation is gone. Judged as a naval weapon, its sole efficiency was proved in the field of scouting, particularly in watching an enemy's ports and harbors. Except in this regard, one hundred thousand tons put into submarines does not begin to compare with an equal tonnage put into surface vessels.

Poison gas and the submarine have not been abolished as yet, but a great step has been taken in the Washington conferences in placing stringent restrictions upon the methods of their use. We are confident that the good work thus begun will be consummated in future conferences by the complete abolition of both these forms of attack.

The Automatic Stop Made Obligatory

THE Interstate Commerce Commission in issuing a sweeping order directing forty-nine railroad systems to equip certain congested sections of their main lines with automatic train control devices has acted in the same spirit which led the government many years ago to enforce the use, on all freight trains, of both the Janney coupler and the automatic brake.

As one of the earliest advocates of the use of the automatic stop, the SCIENTIFIC AMERICAN congratulates the Interstate Commerce Commission on the judgment which it has shown in issuing this order; for the automatic stop is the last logical step in a system for the prevention of collisions, which, commencing with the semaphore, has developed through the block signal (first hand-operated, and then electrically-operated) to the present device, which eliminates the human element, and thus removes an all-too-frequent cause of collisions.

The report states that the investigation by its special train council committee has demonstrated to the satisfaction of the Commission that automatic train-stop devices are practicable. "Our investigations have shown," says the report, "that automatic train control has long since passed the experimental stage. In fact, no safety devices such as the automatic coupler, the air-brake, and the automatic block signal, were perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted." We are told that, after fourteen years of investigation and study, the service tests under varying conditions, and the results obtained in the actual employment of this device over periods of years, have clearly demonstrated the practicability of and the necessity for automatic train-stop control. Hence, it is considered that the time has arrived when the railroads should be required to select and install such devices as will meet the specifications and requirements of the Commission. For the reason that the Commission does not wish to discourage efforts to automatically control trains without the aid of fixed wayside signals, the installation of the automatic stop will not be limited to roads which are already equipped with automatic block signals. It is believed that it is possible to apply train-stop or train-control devices often where automatic block signals are not in use.

As a further protection to the traveling public (to say nothing of valuable freight), the importance of this order can scarcely be overestimated, for it cuts out the possibility of accident through failure of the human element. Faulty vision, carelessness, or sudden physical collapse of the engineer can no longer produce such disastrous collisions as occur too frequently, even in this age of automatic block signaling and improved train and track equipment. It is well within the resources of the mechanical and the electrical engineer to produce automatic equipment which will absolutely prevent collisions, provided it is maintained at all times in first-class working condition. Proof of this is to be found in the New York subway system, where for many years past express trains running at forty to forty-five miles an hour, under a headway of from one and a half to two minutes, have carried over a billion of passengers without the loss of a single life through collision.

It is true that certain automatic stop systems are, or rather were, subject to disablement in storms of snow or sleet; but we understand that there are certain mechanical devices which have completely overcome their winter troubles. Furthermore, one or more systems have been developed in which electrically controlled apparatus on the locomotive is affected inductively by a signal circuit at the track side.

Can Change of Proportions Ever Constitute Invention?

IN a recent decision involving a patent for a metallic alloy, a Federal Court of Appeals has held that while the proportions of the various metals were slightly different from those theretofore employed, there was no evidence to show that the change in proportions had produced any new result. The patent was therefore declared void; but there was a strong intimation that had there been evidence of the sort suggested the decision might have been different. As indicating

Our Point of View

what might have turned the scales, the court cited among other cases the one commonly known as the Minerals Separation Case, wherein the United States Supreme Court sustained a patent for a method which differed from a prior and long-used method only in that there was employed in the process an amount of oil specifically less than one per cent.

There was considerable evidence in this *cause celebré* to show the greater effectiveness of the process carried on with less than one per cent of oil, as against the old process where oil slightly in excess of this percentage was employed. But regardless of this, is it not questionable whether one who merely changes the proportions of known ingredients or agents can be said to have exercised the inventive faculty? Suppose a mining engineer, using an old process and seeking to produce a better operation and improved results, experiments by altering the proportions of certain substances employed in the process. Even if his efforts be highly successful, is it conceivable that he has done anything more than was expected of him in view of his education and experience in the particular work in hand?

Or let us assume that the housewife embarks upon the baking of bread. She follows a recipe which calls for the mixing of flour, water, milk, yeast, shortening; she puts these together as instructed, and gets the oven at the designated temperature, and confides her mixture thereto; and as a result of all this she produces bread. But she is not satisfied and she starts a series of experiments to see whether she can not get a better result. She does not change the ingredients in any way. She merely alters the proportions—a little less milk, a little more shortening, perhaps. In time she produces in this way what she regards as a satisfactory loaf of bread. Has she made an invention?

We do not believe that any court would so hold. The method of attack upon her problem used by our housewife, as by our mining engineer and our metallurgist, bars any claim to true invention. She may have succeeded in getting from the flour more of the nutritive value; it may be she is the first to do this; in the proportions hit upon by her the chemical reactions of rising and baking may be materially different from what they familiarly have been. Yet we can not concede that she is an inventor.

The engineer and the metallurgist who produce new and better results by a change in proportions have done nothing more in their fields than the housewife in hers. With all due respect to the courts in their decisions outlined above, we can not see that anyone who simply varies the proportions of known ingredients in carrying out an old method or in the production of an old alloy can possibly be conceived as having made an invention —no matter how startling the consequences of the alteration in formula which he has made. We well know, for instance, that in the Minerals Separation case the new proportions employed by the patent which was upheld are such as to lead to a process of "flotation" altogether different in theory from that involved in previous separation by oil. But the mere chance unfolding of an unsuspected chapter of natural law by an experiment which any one at all versed in the art might fairly have been expected to try is not, in our mind, invention. Discovery it is, yes: the anticipated discovery of the inventor, never.

We think also that we are justified in applying this reasoning to mechanical construction. Can it ever be said that changing the size and proportions of parts in a machine, even though the machine be extraordinarily improved thereby, involves invention? Would one who takes a child's perambulator and makes it large enough so that it can be used as a horse-drawn vehicle be an inventor? We can see no difference in what all these parties have done. If such patents are sustained it will result in letting down the bars which now separate the realm of patentable invention from that of ordinary mechanical skill, and in materially cheapening the efforts of real inventors.

Airplane Endurance

DID it ever occur to you that endurance, or the ability to remain continuously in the air, is by all odds the most important qualification in the average airplane? We are, of course, well aware that there are special types, such as racing machines, in which long endurance is a secondary consideration; but for the average commercial machine a wide radius of action—the ability to leave the ground and stay in the air hour after hour, independently of landing grounds, fuel supply, and repair men—is the prime consideration.

A machine like the all-metal monoplane, which recently brought the world's endurance record to this country, is to be credited with something more than a brilliant flight in the field of competitive sport. Looked at in its broadest aspect, the fact that this little machine, with two men, went up in a snowstorm, remained aloft throughout a night marked by severe cold and a gale of wind, and came to earth after between twenty-six and twenty-seven hours of continuous flying, proves that it is possible to build an airplane today which compares in reliability with the long-established means of transportation. When the art has been developed to the point where any standard make of airplane can be depended upon to show the same reliability as this monoplane; commercial air travel will increase by leaps and bounds. We are inclined to think that the uncertainty of flying, with its forced descents involving too often fatal accidents, has been the most serious hindrance to the rapid development of airship travel.

Manufacturers of airplanes should encourage flights of long duration such as this. No stronger testimony to the excellence of a machine and its motor can be afforded than a flight of twenty-four hours or more duration, attested by recognized officials.

The rapid rise of the automobile in public confidence and estimation was largely due to the long-distance races in the early years of the development of the art. A machine that could pass through the gruelling test of a 500-mile race, at speeds of from seventy to one hundred miles per hour, left upon the public mind the conviction that the automobile had passed from the experimental to the thoroughly practical stage. This assurance was strengthened by the various transcontinental and other long-distance trips which were achieved at about the same period.

The story of the development of the airplane in respect of its ability to stay in the air continuously, is contained within a period of fifteen years. The official records of duration start in 1906 when Santos Dumont remained in the air for 21 seconds, at Bagatelle, France, in a 50-h.p. Santos Dumont machine. In 1907 Henry Farman lifted the record to 52 seconds, in a 40-h.p. Voisin machine. Then in 1908 Wilbur Wright, in a 24-h.p. Wright machine, made a flight of 1 hour, 31 minutes and 53 seconds, and later in the year raised the record to 2 hours, 30 minutes and 23 seconds. In 1909 Farman, in a 50-h.p. machine of his own make, remained aloft for 4 hours, 17 minutes and 53 seconds, a record which he nearly doubled in the following year with a duration flight of 8 hours, 12 minutes and 23 seconds. In 1911, with one of his 70-h.p. machines, he set the record at 13 hours, 17 minutes and 57 seconds. Little was done in the way of duration flights until 1914, when the 100-h.p. Mercedes engine proved its reliability by maintaining a Roland machine, piloted by Langer, in the air for 14 hours and 7 minutes, and in the same year Boehm, in a 100-h.p. Albatross, brought the record beyond the full-day limit with a flight of 24 hours and 12 minutes.

During the war nothing was done in the way of duration flights, but in 1920 a Farman Goliath machine, driven by two 260-h.p. Salmson motor engines, achieved a duration flight of 24 hours 19 minutes and 7 seconds. This has now been exceeded by the record of our own Edward Stinson, who has improved upon the European record of 1920 by the handsome margin of 2 hours and 28 seconds. In a comparison of the machines, it should be noted that whereas the Farman Goliath machine was equipped with engines of 520 combined horsepower, a single 135-h.p. N.M.W. motor sufficed for the trim little Larsen monoplane.

Are Railroad Cars Too Heavy?

FOR many years past we have been watching with no little interest the steady increase in the size and weight of rolling stock. This increase has taken place in agreement with the well-proved fact that, broadly speaking, the larger the individual unit for the transportation of freight and passengers, the more cheaply can they be carried. This is true both of the steamship and of the railroad car; but it is recognized among steamship men that, because of problems of operation which are peculiar to a steamship of enormous size such as the "Leviathan," there is a limit to which increase of dimensions can profitably be carried. So true is this that it is generally agreed that not for many years to come, if ever, will another "Leviathan" be built.

Now, we are inclined to think that the time has arrived when the railroad man should ask himself whether he has not reached, or indeed exceeded, the limit of size and weight in freight and passenger cars, with coal cars of 120 tons capacity, and Pullman cars that are about 90 feet in length and approximately as many tons in weight.

We are well aware that great size of the individual unit has always been a marked characteristic of our American railroads, and that this is due both to the geography of the country, with its vast distances to be covered, and to the demand of the American people for increased comfort, particularly in transcontinental journeys. We are not now, however, contesting the reasonableness of the demand for great size and weight in our rolling stock, but we do wish to put the question up to the practical railroad man whether in meeting these conditions we have not in, let us say, our 90-foot Pullman car gone a little too far.

The Pullman car is a 90-foot bridge structure carried upon end piers or supports represented by the two trucks. Now the weight of a bridge may be said to increase, roughly, as the square of its length, and it can readily be seen that, as between a train made up of 60-foot cars and one made up of 90-foot cars, there would be a very large saving of dead-weight in favor of the short-car train. In answer to the statement that the weight of a Pullman car makes for greater ease of riding, it is sufficient to say that, although this was true in the days of light rails and indifferent roadbeds, it has but little weight in these days of 100-pound steel rail, and track with eighteen inches of stone ballast.

As to the other fallacy that the great weight of the Pullman of today is conducive to safety, it may fairly be answered that, considered by themselves, superfluous weight and momentum are positive elements of danger in collision. It would be possible to build your lighter 60-foot car with as much relative strength to resist the effects of collision, as is shown by the ponderous 90-foot car. As a matter of fact, a given number of passengers carried in a 60-foot car train of Pullmans would be subject to less danger in the event of derailment or collisions than the same number if carried in 90-foot cars, the inertia of the train being considerably lighter and the destructive effects less. Of course, we are supposing that in both cases the cars are built of steel, and upon approved methods of construction. Additional saving would be effected by substitution of four-wheeled for six-wheeled trucks.

Then there is the question of upkeep of tracks and bridges. The lighter concentration of weight on the four-wheeled trucks would be less severe on the track: the impact at rail joints would be less, and the bridge engineer would find that he could lighten out the floor system of his bridges to no little extent. We offer the above suggestions with an invitation to their discussion.

Radio for Everybody

What the Radio Telephone Service Means and How It Can Be Applied in the Home and Business

By Austin C. Lescarboura

No one has better use for the radio-phone service than the farmer, heretofore isolated from the rest of the world

"LADIES and gentlemen, I take great pleasure in introducing Mr. Percy Grainger, the famous pianist and composer, who will entertain us this evening with several of his favorite pianoforte selections. After that, I must ask you to stand by at 9:55 so that the Arlington station can——"

A concert? No. A vaudeville performance? Hardly. A musicale in the home of a society leader? Not this time.

It is merely a bit of radio-phone service taken at random. Another time it might be Mme. Lydia Lipkowska, court singer to the late Czar of Russia, or Miss Valentina Crespi, violinist, or Miss Sophie Tucker famous delineator of darky and character songs. Again it might be Governor Edward I. Edwards of New Jersey, with his Christmas message, or John Steele, star of "Monsieur Beaucaire," or Herschel Jones, Director of Foods and Markets, New York State. Still again, at a different hour of the same day, it may be the news of the day, carefully selected and clearly heralded, word by word; marine news, weather reports, children's bedtime stories, or other items of interest in the home or business.

The Radio Voice and Its Audience

What is the radio-phone service? Where is it obtainable, and how? What does it cost?

Typical questions, these, at a time when radio is at the height of popularity. Only a short twelve months ago the hobby of radio was indulged in by boys and young men, with occasionally a full-grown man, who, perhaps, were more fascinated by the technicalities of the radio art than by the actual feat of communication through space. It is true, the radio amateurs then as now were carrying on radio conversations among themselves by means of the dot-dash tongue of the telegraph code, but it was evident that they spent a goodly part of their time arranging and rearranging their radio transmitters and receivers in their insatiable ambition to cover greater distance.

Then came the radio-phone service, not as an occasional thing to startle the radio amateurs already engaged in sending and listening to the dot-dash-dot messages, but as a regular established practice. A subsequent development brought about a definite program, so that the person with a radio receiving set now can obtain a printed program which gives the features for each evening of the forthcoming week.

And here is what we find: In various cities throughout the country there are radio-phone broadcasting stations which send out the news of the day, special talks, sermons by clergymen, marine news, weather reports, children's stories, and, most important of all as far as the average home is concerned, an elaborate musical program. With the proper type of receiving set, it is now possible for anyone to receive the radio-phone service from the nearest station, and, if there are a number of stations within receiving range, it is often possible to receive several radio-phone services, one by one, with absolute selectivity, although they are operating simultaneously. That is to say, with the apparatus properly tuned, one station may be heard; then, by slightly altering the tuning, another station will be heard, and so on. So sharply tuned are the radio-phone broadcasting stations that selectivity at the receiving end is quite practical, and whenever it is so desired one can select one's favorite radio-phone service with the same facility with which one selects a given phonograph record in preference to others.

Singer and accompanist at a broadcasting station, with the microphone shown at the right

All of which brings us down to the elements of radio communication, in order that we may have a better understanding of what is required in radio-phone broadcasting and reception.

SUFFICIENT evidence that everybody is interested in radio telephony would be afforded by our mail bag alone, which of recent weeks has been heavy with inquiries on the subject. Not with any desire to discourage these, but simply in order that the fundamentals of the subject might be presented more fully and with less labor than is possible in individual letters, we have prepared the accompanying article, which endeavors to meet the simpler of the doubts and questions that exist in the mind of one being introduced to wireless or radio for the first time. It will be followed by other articles, of none the less general appeal we hope in spite of the fact that they will go considerably further into the subject. Among the things which we have already planned thus to discuss are radio telephone transmission on a small scale; continuous-wave telegraphy, which is enabling radio amateurs to cover great distances with a remarkably small output of energy; the amateur transatlantic transmitting tests with continuous-wave transmitters; a survey of receiving apparatus for all varieties of reception purposes, and so on. In the meantime we invite inquiries on any phase of radio, or suggestions as to topics in the radio field which we might advantageously cover in our pages.— THE EDITOR.

Radio communication comprises three definite operations: First, we must have a suitable source of radio energy, known as the transmitter, which is capable of imparting this energy to space, or ether, as it is called by the physicist. Secondly, the radio energy, converted into vibrations of the ether, is propagated through space in ever-increasing circles over the earth's surface, losing its power as it extends farther and farther away from the source, just as the ripples set up by a stone cast into a body of still water spread out in ever-increasing circles which become less and less pronounced as they go away from the center. Thirdly, an instrument capable of detecting the disturbances in space or ether is set up at any desired point in order to intercept whatever message or sounds the radio waves may convey. This instrument is known as the receiving set.

Now, it must seem quite evident that the more powerful the transmitter employed, the more far-reaching must be the radio waves. Conversely, the more sensitive the receiving set, the greater its ability to receive weak radio waves. In fact, with a given receiving set the radio waves from a transmitter three hundred miles away may be too weak to be detected, while the same waves can be readily detected and heard with an elaborate receiving set which includes suitable sound-amplifying apparatus.

A Question of Distance and Price

So the reception of radio-phone service resolves itself down to a matter of distance from the transmitting station, and the receiving set employed. Let us take a typical instance: One of the foremost broadcasting stations is that of the Westinghouse Electric and Manufacturing Company at Newark, N. J., designated as WJZ. All radio stations, by the way, have certain call letters to identify them, just as automobiles have license plates. It would not be practical for every radio station to give its full name, ownership, power, location and other facts every time it sent a message. Hence a call letter, assigned by the Government, serves to identify the station, while special call books tell at a glance what each call letter represents.

To return to WJZ, located at Newark, N. J.: The radio-phone service broadcasted by that station may be divided into imaginary zones. First there is the 25-mile zone, which takes in all of Greater New York, a good part of Westchester County to the north, a little of Long Island beyond the city limits, and a considerable stretch of New Jersey suburbs. If you are within the 25-mile zone, you are indeed fortunate, because the simplest kind of receiving set will enable you to receive the radio-phone service. Thus a $25 receiving set will give the utmost satisfaction, in connection with a pair of head 'phones which are included with the set. If more than one person must listen in at one time—and it is no uncommon occurrence for several members of the family to lay claim to the 'phones when there is a real treat in the air—an additional set of 'phones may be added. Single 'phones, which may be held up to the ear, will also serve quite nicely where a number of persons are to listen in at one time.

WEEKLY PROGRAM
RADIO-PHONE SERVICE
WESTINGHOUSE ELECTRIC & Mfg Co.
STATION W J Z, NEWARK, N. J.

MON., DEC. 12th, TO SUN., DEC. 18th, 1921.

This program can be heard by any one with suitable radio receiving apparatus within a radius of 100 miles of Newark.

The service is absolutely free.

Tune Instruments for 360-meter waves.

REGULAR CONCERT
DAILY, 8:20 to 9:25 P. M.

MONDAY - - - Mme. May Peterson, Prima Donna Soprano, Opera Comique, Paris

TUESDAY - - - Os-Ke-Non-Ton, Indian Baritone; Messrs. Bertram Haigh and Ralph Brown, French horns; Miss Anita Wolf, Pianist

WEDNESDAY-Mme. Gretchen Hood, Prima Donna Soprano, Theatre de la Monnai, Brussels

THURSDAY - - Miss Helen Davis, Soprano; M. Cliff Young, Pianist

FRIDAY - - - Westminister Orchestra

SATURDAY - Dance music

SUNDAY - - Miss Ethel Mackey, Soprano and Miss Mary Emerson, Pianist. Sacred Music

OTHER FEATURES

General News - - Newark Sunday Call News Service, daily, 7:55 P. M.

Children's Hour - - "Man-in-the-Moon" stories, by *Miss Josephine Lawrence* © Newark Sunday Call Tuesday and Friday, 7:00 P. M.

Hourly News Service - - Newark Sunday Call; weekdays, every hour from 11.00 A. M. to 7:00 P. M. on the hour.

Radio Amateurs' Night - - Thursday 7 P. M. J. B. WALKER editor Scientific American

Weather Forecast (Official Gov't) - - Daily, 11:00 A. M., 5:00 and 10:03 P. M.

Marine News - - Marine Engineering Service, weekdays (except Saturdays), 2:05 P. M.

Official Arlington Time - - Daily, 9:55 P. M.

(Program subject to change)

Typical program of a radio-phone broadcasting station, mailed out weekly to interested parties

But let us consider the case of a person outside the 25-mile range. Consider the person in Trenton, which is some 50 miles distant from WJZ at Newark. In order to receive the WJZ radio-phone service, this person will have to employ a more elaborate set. The simple $25 one is no longer effective at this range. Of course, radio is by no means uniform, and there are freak conditions when a $25 set may receive over a much greater distance than normally. But it would be poor policy to count on freak conditions, hence we must consider the problem in absolute terms. Therefore, we must employ a receiving set with more elaborate tuning equipment, making use of a vacuum tube detector in place of the crystal detector of the cheaper sets. Such a set may cost upward of $50. Indeed, to quote Mr. Louis Pacent, a well-known authority, radio telephony may be received at a cost of $1 for each mile of distance spanned.

Going outside the 50-mile zone, let us consider an individual in Philadelphia or Albany or Atlantic City. Any one of these points is so far from WJZ that a

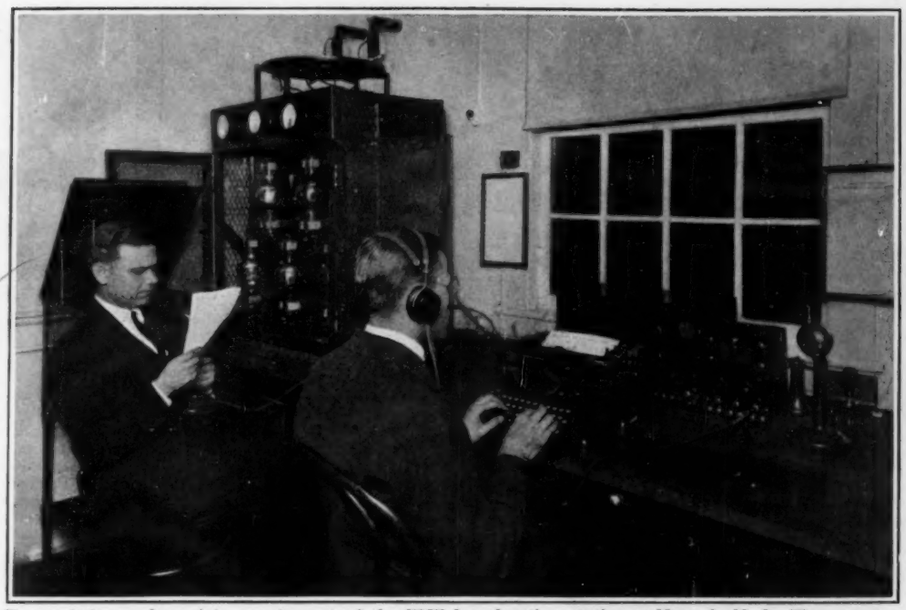
most elaborate receiving set is required, which not only tunes sharply and possesses a vacuum tube detector, but also comprises amplifying equipment to build up the attenuated radio waves to suitable audibility. Such a set must cost in the neighborhood of $150 complete, for it involves a number of vacuum tubes, storage battery, tuning panel, amplifying panel, head 'phones, high-voltage dry battery, and so on.

What Is a Crystal Detector and a Vacuum Tube?

A radio receiving set is simple, once you have overcome that awe inspired by the array of knobs and dials and name-plates with formidable terms. The receiving set must possess some suitable tuning device. All radio waves sent out by a transmitter have certain values, just as rays of light have different colors and shades. If you wore a pair of special glasses which only permitted a given shade of pink light to pass through to the eyes, you might say you were "tuned" for that shade of pink light. Blue light, yellow light, green light, purple light, and all other colors and shades save pink would not be seen by you, providing it were possible to make such accurate color filters.

Now in radio the same situation holds true, and with great precision. The radio waves are of different values, and these values are expressed in terms of meters of wave length. WJZ, for instance, transmits on 360 meters. When you manipulate the tuning knobs of a receiving set so as to have the 360-meter adjustment, you can hear the WJZ station. Tune down to 200 meters, and you hear some nearby radio amateur. Tune up to several thousand meters, and you hear the high-power transatlantic stations. Hence it is the tuning of the transmitter and the tuning of the receiver which makes selectivity possible in radio communication. It is for this reason, too, that a number of transmitters can be working at one time without messing up each other's dispatches or concert; for the receiving operators can each tune their apparatus to the desired transmitter, while eliminating the undesirable waves. Most receiving sets receive radio telegraph and radio-phone waves alike.

In the receiving set—and we are only interested in reception this time—tuning is accomplished by varying the inductance and the capacity. These terms are familiar to the person with an elementary knowledge of electricity. The inductance variation is generally obtained in steps by taking taps at every so many turns of a single layer of wire wound on a large tube, said taps being connected to the points of a switch or to binding posts, or again to so-called bayonet sockets which engage with suitable plugs. The finer adjustment may be accomplished by a sliding contact operating on a single-layer coil, the wire being bared so as to give suitable electrical contact. This form is called a tuning coil. Again, the finer adjustment may be obtained by what is known as the variometer principle, in which a movable coil rotates within a fixed coil, so that the windings are either arranged for the current to flow in the same direction in both of them, or in opposite directions, or any intermediate condition. When the windings are in the same direction the inductance is greatest; when arranged in the opposite directions, or "bucking," the inductance is lowest.



Transmitting and receiving equipment of the WJZ broadcasting station at Newark, N. J. The operator at the left is announcing the news of the day, while the operator at the right is receiving weather reports

Inductance is also varied in big steps or jumps, by means of compact coils. Formerly, long or tall tubes, wound in a single layer with hundreds and even thousands of turns of wire, served the same purpose. The contrast between a loading coil, as it is called, a yard high, and the present-day compact inductance coils, must be as startling to the layman as the technical characteristics have been to the radio profession.

Capacity is another factor in determining wave length. Adjustable condensers are employed for this purpose. The most common type of condenser consists of a group of fixed aluminum or brass plates, and a group of movable plates which pass in and out of the stationary plates when the handle is turned. Of course, the two groups of plates do not touch each other, the surrounding air serving as the dielectric or non-conductor.

Aside from tuning, it is necessary to convert the intercepted radio waves into audible signals. This is accomplished by what is known as the detector, and the telephone receiver. The detector may be of the crystal type or the vacuum tube type. The former is the simplest and least expensive, consisting of a suitable mechanism for bringing a metal point or wire to bear on a mineral crystal, or two crystals in contact with each other. The vacuum tube is a modified form of electric lamp in which other elements have been introduced aside from the usual filament. Vacuum tubes operate on one or more cells of dry battery, depending on their voltage rating, and preferably on a storage battery. A 22½-volt battery is also necessary, this unit being known as the "B" battery.

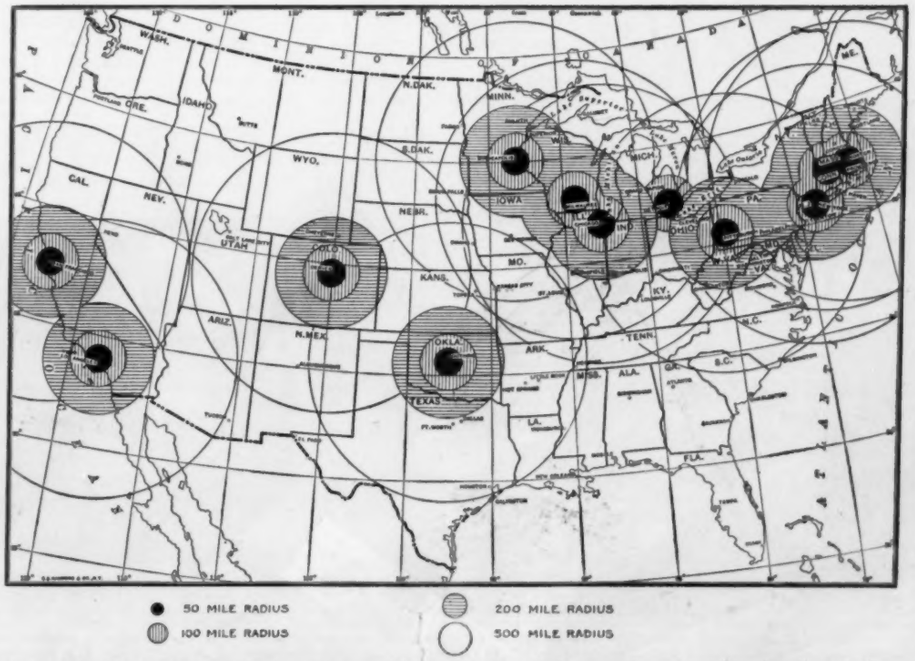
The detector serves to transform the intercepted radio signals or waves, which have been tuned in, into audible signals or sounds in the telephone receivers. In case of the crystal detector, one of the members, which may be a wire, a metal point, or a pointed crystal, is adjusted until a sensitive spot is found on the large crystal. The detector has to be readjusted each time it loses its sensitiveness. The vacuum tube, on the other hand, is more constant and positive in operation, and is adjusted by means of a rheostat which controls the flow of filament current. Furthermore, there is scarcely a comparison between the relative sensitiveness of the two types of detector: the vacuum tube is many times more sensitive than the usual crystal.

Aerial, Ground, and the Loop

Nothing has been said, so far, regarding the means of imparting the radio energy to space or ether, and the means of intercepting the radio waves at the receiving end. These functions are realized by means of elevated and insulated wires, which form the aerial or antenna, as well as a ground connection. The ground connection may be made to any water supply or gas pipe.

For transmitting, a large aerial is required; a large station, such as the Radio Central at Rocky Point, Long Island, transmits across the Atlantic with an aerial comprising 16 wires 1½ miles long and 410 feet high. That, of course, is exceptional, and means nothing to us except by way of general information. Receiving, on the other hand, requires only a small aerial. A single wire, insulated with ordinary porcelain knobs or cleats such as are used in exposed wiring, stretched 100 feet long between a house and a clothes pole or a tree, should be ample. Two wires may give better results, and longer wires should certainly stand for better results since more energy is intercepted the greater the aerial.

The question of a receiving aerial is much the same as that of distance. Given a better grade of receiving apparatus, naturally a smaller aerial is required for a desired result. Thus it comes about that a radio amateur acquaintance, located in Boston, receives the radio-phone service from the Newark station and the East Pittsburgh station, using nothing more than a 40-foot length of magnet wire concealed about the living room



Map of the United States, showing the approximate location of the more important broadcasting stations in actual operation or about to be opened. The circles indicate the various zones covered, at different ranges, and are intended for the guidance of the radio audience

Left: Typical $25.00 receiving set, comprising a simple tuner operated by a single handle, a crystal detector, and a telephone head set. This type of receiving set is suitable for use in the 50-mile zone with a large aerial, although it is only recommended for the 25-mile zone. *Center:* Typical $75.00 receiving set, comprising a two-adjustment tuner, filament rheostat, single vacuum tube detector, and telephone head set. The vacuum tube in this particular set operates on a single dry cell instead of a costly and messy storage battery. It draws only ¼ ampere of current, and a dry cell will last about 90 hours with intermittent use. This type is suitable for the 50-mile to 100-mile zone, or within the 50-mile zone when loudness is a prerequisite, or when a small aerial must be used. *Right:* typical receiving set of the more elaborate kind, with tuning unit, vacuum tube detector, two-stage vacuum tube amplifier, and telephone set. This set may be used with a loud-speaker, making the telephone head set unnecessary. The cost runs upwards of $125.00, and the radio-phone service may be picked up well outside the 100-mile zone

Three typical receiving sets suitable for use at various distances from radio-phone stations

molding. But it is the quality of his receiving apparatus, not to forget his two-stage amplifier, that makes this feat possible. Were this same amateur anxious to receive from stations many times farther away, he could do so by erecting a fair-sized aerial. If the aerial is small, a better receiving set is required, and amplifiers are necessary.

One of the wonders of present-day radio is the so-called loop. Instead of employing an aerial and a ground connection, a simple frame with a half dozen turns of insulated wire may be employed. This frame can be used indoors, and it simplifies the problem of radio reception in many instances. However, since the loop does not begin to intercept as much energy as the usual aerial, it is necessary to fall back on amplification so as to bring up the signal or sound strength.

Amplifying apparatus makes use of vacuum tubes which differ but slightly from detector tubes. The difference is merely a matter of the degree of vacuum in the bulb, and detector and amplifier tubes can be used interchangeably if necessary. In conjunction with the vacuum tubes various pieces of apparatus are used, such as closed-core transformers, sockets, small condensers, and so on. It is well to mention here, however, that the beginner in radio will do well to purchase complete units rather than parts. Radio equipment comes in units, such as a variometer unit, a condenser unit, a detector unit, a one-step or two-step amplifier, and so on, and also in complete sets. It is largely a matter of choice whether to purchase units which enable the operator to add to his set and rearrange the components to suit varying conditions, or a single set which requires no extensive wiring.

The broadcasting stations are to the radio receiving set what records are to the phonograph. One is not complete without the other. Therefore, the first consideration is to survey the broadcasting situation before going ahead with receiving plans.

Where the Music and News Come From

The radio-phone service is a new development, and as such it is still in its infancy despite the great wave of popularity which it has created for radio. It is not so long ago that the Westinghouse organization began operating the East Pittsburgh broadcasting station, following the plans of their M. C. Rypinski, to whom belongs the commercial credit for introducing the present radio-phone service. But it was not until the Westinghouse organization opened up the Newark station that the service became highly popular; the Newark station, incidentally, can broadcast to one-tenth the population of the United States, because of its location in the most densely populated area. Today radio broadcasting stations are planned for early inauguration in the leading cities of the country, so that any list of stations is almost certain to be incomplete by the time it is off the press.

The leading radio-phone broadcasting stations, operating on a regular program, are as follows:

KDKA *East Pittsburgh:* Westinghouse; 330 meters wave length. Sends out music at 9 P. M. to 10 P. M., except Sundays. News, 9:30 P. M. except Sundays. Market reports, 8:05 P. M. except Saturday and Sunday. Organ recitals, Saturday 8:15 P. M. and Sunday, 4 P. M. Sermons, Sunday 7:45 to 9 P. M. Range, 1000 miles.

WBZ *Springfield, Mass:* Westinghouse; 375 meters wave length. Concert, Monday, Wednesday, Friday, 8 to 9 P. M. Sermons, Sunday, 8 to 9 P. M. Range, 500 miles.

WJZ *Newark, N. J.:* Westinghouse; 360 meters. Concert, 8:20–9:15 P. M. daily. Alternates its program with WDY. Range, 1000 miles.

1XE *Medford Hillside, Mass.* (near Boston): Amrad; 350 meters wave length. Music, Wednesday evenings. Sermons, Sunday evenings. Police reports, daily at 7:45 P. M.

KYW *Chicago, Ill.:* Westinghouse; 360 meters. Music and other features daily, 8 to 11 P. M. 750 miles.

6XC *San Francisco, Cal.* (California Theater): Atlantic-Pacific; 1250 meters. Concert and news daily except Sundays for 30 minutes, starting at 4 p. m. 7:15 P. M., and 9 P. M. Range, 1000 miles.

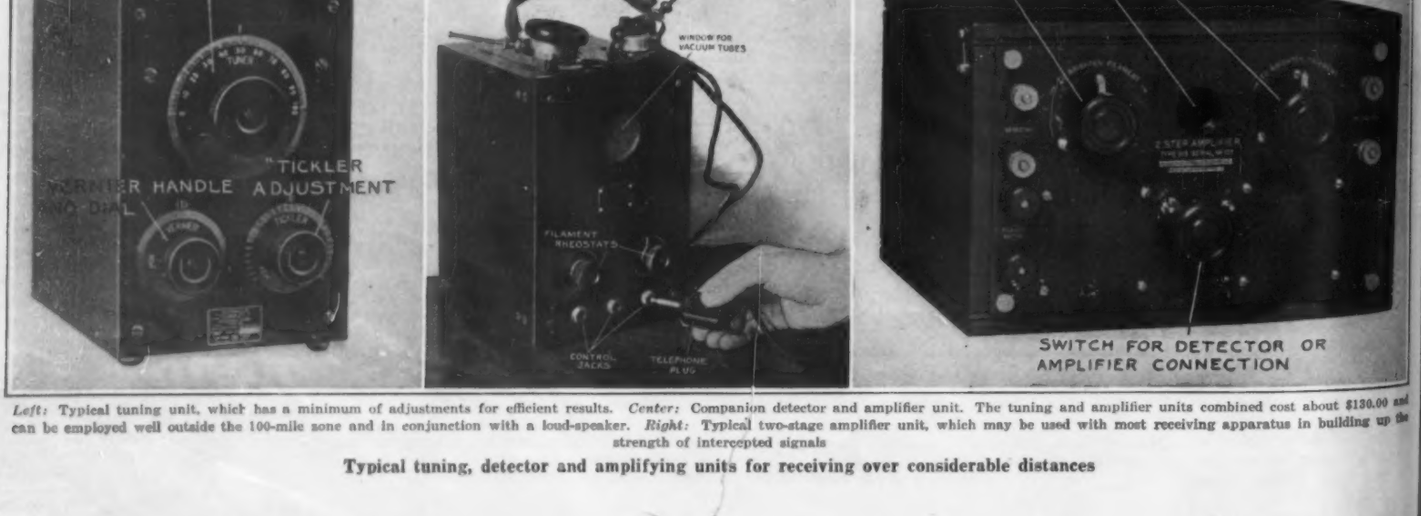
6XG *San Francisco, Cal.:* Meyberg; 350 meters. Press, weather, grain and produce reports daily except Sundays, 4:30 to 5:30 P. M., and 7:45 to 8 P. M. Concert, Monday, Thursday, Saturday, 8 to 9 P. M. Sundays, 10 to 11 A. M.

WDY *Roselle Park, N. J.* (near Newark): Radio Corporation; 360 meters. Music, opera, lectures and radio parties; alternating its service with WJZ.

6XAK *Los Angeles, Cal.:* Meyberg; 266 meters wave length. Concert, daily except Sundays, 4 to 5 P. M. Monday, Thursday and Saturday, 8 to 9 P. M. Range, 500 miles.

The foregoing is but a partial list. There is a station at Los Altos, Cal., operated by Coleman B. Kennedy, which sends out interesting radio-phone talks on 360 meters wave length. A station is being installed in Detroit, and while it will be of low power, it will supply a radio-phone service to that progressive region. An-

(Continued on page 220)



Left: Typical tuning unit, which has a minimum of adjustments for efficient results. *Center:* Companion detector and amplifier unit. The tuning and amplifier units combined cost about $130.00 and can be employed well outside the 100-mile zone and in conjunction with a loud-speaker. *Right:* Typical two-stage amplifier unit, which may be used with most receiving apparatus in building up the strength of intercepted signals

Typical tuning, detector and amplifying units for receiving over considerable distances

Research Settles the Problem of Tunnel Ventilation

The Best System for Supplying Fresh Air to the Hudson River Vehicular Tunnel Tube Is Determined

By Robert G. Skerrett

THE ventilation problem of the Hudson River Vehicular Tunnel has been solved, and there is no longer room for the least doubt that the twin tubes, when finished, can be operated to capacity without menace to man or beast. The essential facts have been established after well-nigh two years of exhaustive experimental research, which has involved a total outlay of more than $80,000. In this epoch-making work the U. S. Bureau of Mines and a number of eminent experts have collaborated with the technicists immediately in charge of the construction of the subaqueous highway.

Under-water vehicular tunnels have linked the two shores of the Thames River in England for some years, but these traffic arteries are considerably shorter between ventilating openings than the tubes that are to be driven beneath the Hudson so as to facilitate communication between New York City and neighboring New Jersey. Further, since the English tunnels were built, the use of self-propelled vehicles has increased to a great extent, and conveyances of this sort will predominate in the large volume of traffic which the New York–New Jersey tubes are expected to take care of. Therefore, the outstanding question has been one of insuring a sufficient supply of fresh air at all times to neutralize the gaseous exhausts of numerous internal combustion engines.

The whole subject of ventilation divides itself broadly into three divisions: first, the vital one having to do with the physical well-being of persons using the tunnel and of draft animals thus threading their way from shore to shore; second, the physical means employed to effect a proper distribution of fresh air on one hand and the withdrawal of the vitiated air on the other; and, finally, how this movement of inbound and outbound air could be maintained at the lowest operating cost—especially as the blowers for this purpose are required to be powerful enough to insure a complete change of the air within each tube every minute and a half.

Logically, the first division of the matter was interwoven with the probable quantity of noxious gases which would have to be diluted and removed from the tubes during rush hours or whenever, for any reason, motor-driven vehicles, with their engines running, might be brought to a standstill in the tunnel for some while. Therefore, the primary investigations had to do with the amount of gas generated by automobiles and motor trucks at various speeds and under different operative conditions of the engines, as well as the determination of the measure of the most hurtful of the exhaust gases, i.e., carbon monoxide. This line of inquiry was pursued by the U. S. Bureau of Mines under the auspices of the officials of the Pittsburgh Experimental Station. The physiological aspect of the problem was taken in hand at Yale University and supervised by Doctor Yandell Henderson, acting for the time as consulting physiologist for the U. S. Bureau of Mines.

In their preliminary estimates, the engineers of the Hudson River Vehicular Tunnel Commission had figured that it would be safe for human beings to be exposed to a mixture of 3 parts of carbon monoxide in 10,000 parts of air. The researches at Yale demonstrated that even infants and invalids could breathe without ill-effects and for a considerable period a combination of 4 parts of carbon monoxide in 10,000 parts of air. This indicated, at first blush, that much less fresh air would have to be forced into the tubes to maintain a satisfactory atmosphere. This encouraging revelation was, however, somewhat offset by the disclosures at Pittsburgh, for it was there established that cars and motor trucks would generate more carbon monoxide than was originally calculated. Accordingly, it was apparent that the ventilating blowers would have to be of ample capacity to dispose of the increased volume of gas—in other words, there would be no saving in mechanical equipment.

With these two matters settled, the next phases of the subject to be analyzed were those relating to the power needful to force fresh air in and to withdraw the vitiated atmosphere as well as to the method best suited to accomplish these ends. Again, the Tunnel Commission entered into a contract with the U. S. Bureau of Mines, and the latter, in its turn, made arrangements with the University of Illinois to conduct a series of tests at the latter's engineering experiment station situated in Urbana. The purpose of these tests was threefold and as follows: first, to determine the coefficient of friction of the flow of air in concrete ducts such as are planned for the tunnel; second, to verify the formulæ used in computing the power required for moving air through a duct from which air is to be taken off at specified intervals; and, third, to ascertain the power losses in the bends of flues, ducts, or airways.

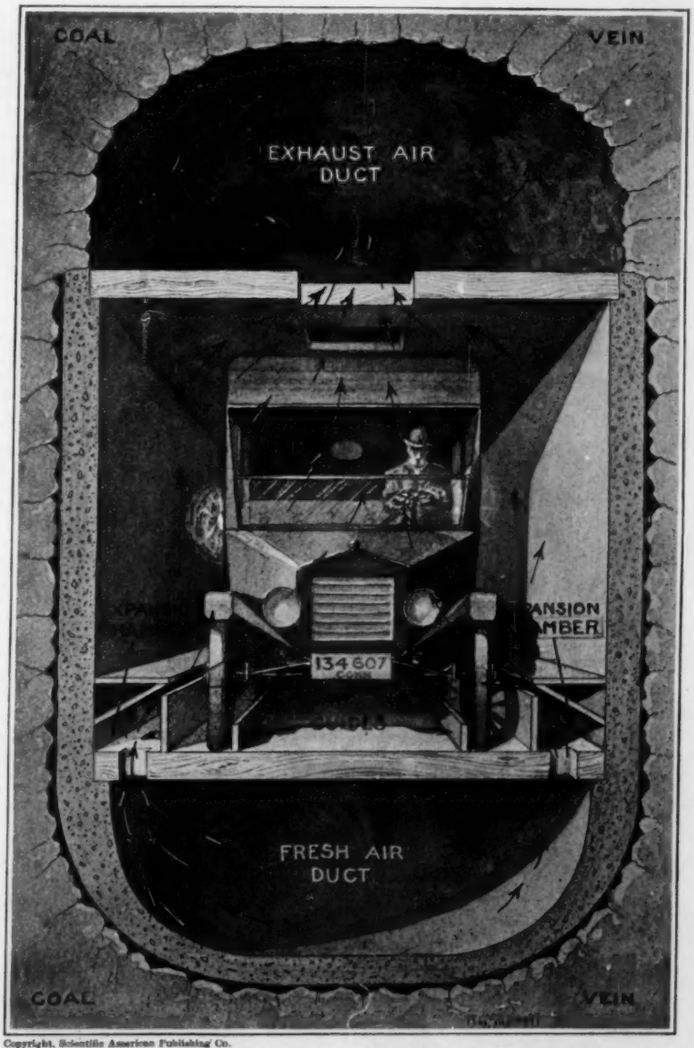
To this end there was built at Urbana a timber and concrete structure 300 feet long, representing in cross-section a half-sized model of the air duct that will be constructed beneath the roadway of each of the twin vehicular tubes. Surmounting this experimental duct were reared three reading stations, in each of which were installed a variety of gages and other apparatus for registering air pressures under divers conditions of operation. At the intake of the duct was set a large electrically-driven fan capable of supplying more than 100,000 cubic feet of air per minute; and later on there was erected at the other terminal an elbow typifying the connection between a tunnel tube and a ventilating shaft. Along each side of the duct there were spaced at short intervals ports or openings through which the air from the blower could escape from the duct, and these were arranged so that the amount and pressure of the exhausting air could be regulated and measured.

The plan for ventilating the tunnels when finished calls for a dual system in each tube. That is to say, there will be a ventilating plant on each side of the Hudson, and each equipment will deal with only half of the tunnel—division bulkheads being placed in the exhaust and the fresh-air ducts midway in the length of the tubes. The model duct at Urbana was about one-third as long as the full-sized duct will be when spanning the distance between the outermost ventilating shaft and the center of the river. One of the primary desiderata of the engineers was to make certain that it would be practicable to insure a uniform distribution of air from end to end of the subaqueous highway; and the object of the experiments at Urbana was to disclose how this could be accomplished and what would be the power required to maintain the necessary flow of air. The problem was both a mechanical and an economic one, for ultimately it would have to do with the annual outlay involved in driving electrically an aggregation of 65 blowers, ranging from 20 to 300 horsepower each.

As may be readily grasped, the ultimate arrangement of each fresh-air duct will, in principle, be not unlike that of a pipe closed at one end, receiving air at the other, and being pierced at specified intervals by numerous outlets. Such being the case, how could the ports remote from the blower exhaust as much fresh air as those closer to the fan? Plainly, there must be no pockets of dead air in the actual tunnel, nor must there be any appreciable difference in pressure at any point along the line of travel. The work at Urbana resolved itself into some very interesting studies in pneumatic engineering; and because of the scale on which the tests were run the results were decidedly unlike those predicted by the textbooks and which are based upon experiments of a far less pretentious character.

For the sake of those not familiar with the subject, it should be borne in mind that static pressure represents resistance to flow, while the velocity pressure is a direct indication of the quantity of air handled. When the velocity pressure drops the static pressure rises, and vice versa. The coefficient of friction varies with velocity—*i.e.*, the higher the velocity the lower the coefficient of friction. The aim of the investigators at Urbana was to obtain a nice balance of these forces so that, with a minimum of propulsive effort, an equal volume of fresh air should be available everywhere throughout the length of the experimental duct.

Theoretically, the outlets farthest from the blower should have to be larger than those nearby because of the reduced volume of air remaining for distribution; but, curiously, the tests proved this to be quite to the contrary. The back pressure built up at the remotest section of the duct actually made it necessary to reduce the size of the outlets there so that they would be smaller than those of the middle section of the structure, thus showing that there would be plenty of air at the extreme end of the duct. Another revelation of importance was that regarding the coefficient of friction. The demonstrations disclosed this factor to be only about half of that usually stated in manuals on the subject.



Cross-section of experimental tunnel in a coal mine at Bruceton, Pa., where operating conditions of the Hudson tunnel were faithfully reproduced, even to the temperature

Let it be said here that the outlets along each side of the duct represented the passages by which the escaping fresh air would, in the vehicular tunnel, reach the traffic space; and the question for the investigators was to settle upon some type of intervening expansion chamber which would best serve to effect a widespread dispersion of the air into the driveway. It was essential that the air have sufficient impulse to carry it to the center of the road and yet produce no sensible draft 5 feet away from the point of discharge. No fewer than 25 models were built and tried out before a satisfactory pattern of expansion chamber was developed.

The concluding work at Urbana was devoted to the discovery of an efficient form of combination elbow that would reduce to a minimum the resistance of air flowing either in or out of the duct at a juncture simulating a connection with a ventilating shaft. Because of the turns which the air stream would have to take in entering or leaving the duct, it was realized that considerable power would be needed to overcome the retarding action of the bends. A number of bend models were experimented with in the laboratory before building the final combination elbow. Here was a point where there would be a waste of energy unless the static pressure could be cut down. The desired result was obtained by interposing in the elbow, axially with the stream flow, a partition or vane which had the effect of forming two ducts instead of one in the bend. As a consequence, the velocity of the air was increased and the static pressure diminished proportionately. In short, the vane in the airshaft elbow lessened by 25 per cent the force required to drive the air through the turns. To sum up, the disclosures at the engineering experimental station at the University of Illinois, in combination with certain features developed there, indicate that the ventilating power plant, as originally outlined by the tunnel engineers, will be ample for the fullest service that can be imposed upon it by a maximum movement of self-propelled vehicles.

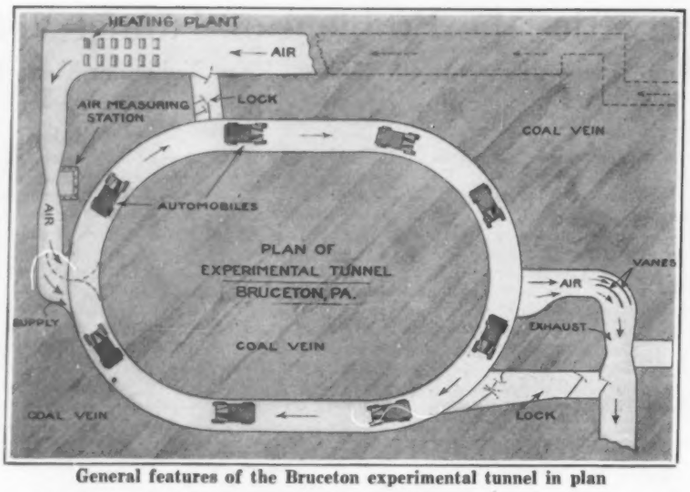
And now we come to the climatic stage of the investigations instigated by the tunnel engineers—those researches which were made at Bruceton, Pa., a few miles from Pittsburgh, to determine whether or not it would be wisest to distribute the fresh air through the lower duct of the tunnel and to withdraw the vitiated air by way of the upper duct. To this end the cooperation of the U. S. Bureau of Mines was again sought. It had been repeatedly urged upon the Tunnel Commission by outside technicists that the fresh air supply should be fed down into the traffic way from the overhead duct and the foul air and gases carried off by the lower duct, because this arrangement would catch the harmful gases near their points of generation and dispose of them by the shortest route. These men vigorously declared that any other course would be unsatisfactory if not dangerous to life.

On the face of it, this argument seemed sound, and with characteristic open-mindedness Mr. Clifford M. Holland, Chief Engineer of the joint New York and New Jersey Tunnel Commission, recommended that the question be settled in a practical manner. This was done in an oval tunnel, located 130 feet below ground, in the very heart of the Government's experimental coal mine. The subterranean speedway was constructed by linking with curved galleries two existing neighboring, parallel drifts. The cross-section of the excavations through the coal seam was large enough, when the tunnel was partly lined with concrete, to form a rectangular space 9 feet wide and 7½ feet between the floor and ceiling. This left an upper air duct 5 feet high and another beneath the roadway 4 feet high. The axial length of the oval tunnel is 400 feet.

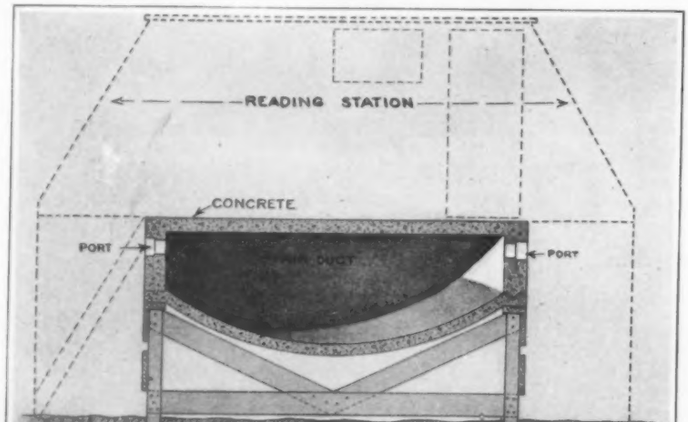
At 8 stations, 5 feet apart on one of the straight sections of the speedway, were set up 8 complete stationary air sampling tubes, and all of these were connected by piping to a central sampling station, where a pump was installed for gathering the air from the tubes. The air-collecting system operated during half-hour periods, and the sampling bottles or tubes were placed where they could obtain air at different levels of the speedway. During each run, the cars were also equipped with sampling tubes located as follows: one on top, one at the driver's feet, and a third half way between these points. The automobiles were driven at a speed of 10 miles an hour; and the maximum number of vehicles in any of the tests was eight. Sampling tubes were likewise set up in the exhaust duct at one station where samples were taken continuously to determine the composition of the air as it left the tunnel. This arrangement served as a check on the other readings. Each machine was provided with an exhaust-gas sampling apparatus and gasoline-measuring facilities. By means of these various devices data were obtained that minimized errors that might otherwise have discounted the findings had only one system of observation been employed.

At Bruceton, fresh air was admitted to the tunnel both through the lower duct and the upper duct for the purpose of establishing the relative efficiency of each method. Altogether there were seventeen demonstration tests, and during these fresh air was supplied eleven times from the lower duct, and six times from the upper one. The natural tendency of the hot exhaust gases to rise quickly, and the structural features of the tunnel, contributed to make the upward removal of the foul air more effective. Furthermore, the doctors in charge of the physiological tests claim that the blood absorption of gas is less pronounced when this movement is maintained, assuming that the percentage of carbon monoxide is the same whether fresh air is supplied from below or from above the speedway.

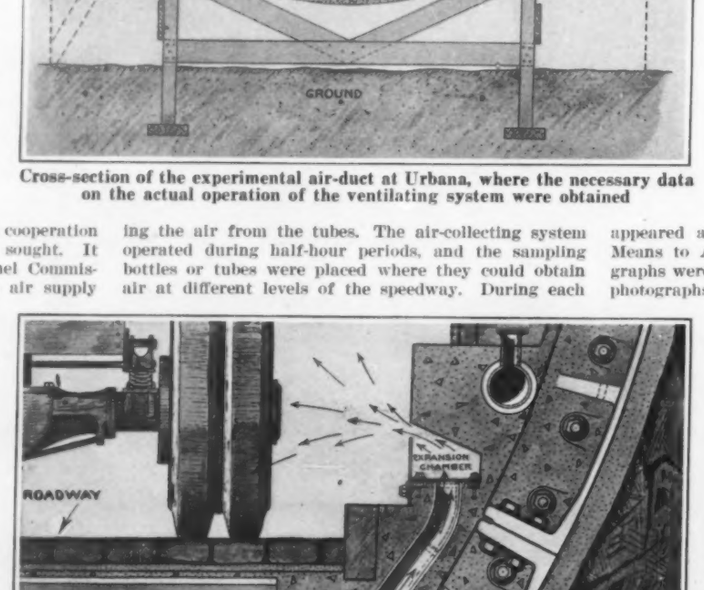
The interested public may now rest content that the great engineering undertaking henceforth to be pushed to completion will involve no unsolved ventilation problems. This vital aspect of the project has been authoritatively settled; and passengers through those twin tubes will have nothing to fear from a lurking excess of noxious carbon monoxide. The air in the tunnel will be safe to breathe during the longest interval that anyone will have to remain below the river in making the passage from shore to shore. The data obtained through the experiments described will furnish basic information of prime importance in the prosecution of numerous engineering undertakings.



General features of the Bruceton experimental tunnel in plan



Cross-section of the experimental air-duct at Urbana, where the necessary data on the actual operation of the ventilating system were obtained



Partial cross-section of the Hudson River Vehicular Tunnel as it will be built, showing approved arrangement of fresh-air duct and expansion chamber by which the good air will be forcibly delivered to the roadway

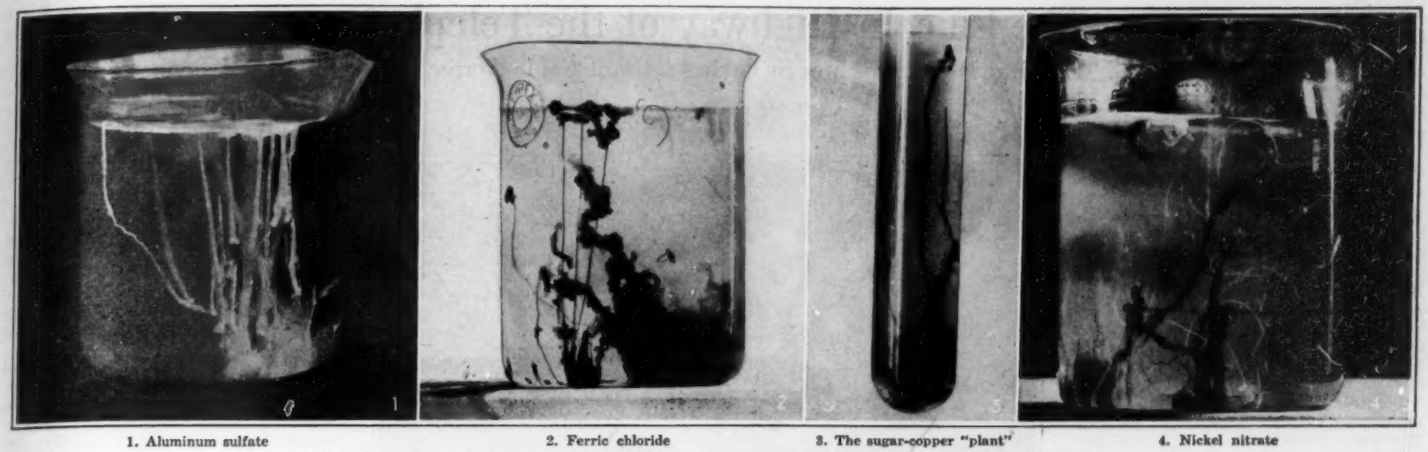
Credit to Whom Credit Is Due

IN the September issue of the former SCIENTIFIC AMERICAN MONTHLY there appeared an article entitled "Asbestos and What It Means to America." A number of interesting photographs were used in conjunction with the article. These photographs were furnished by the Asbestos and Mineral Corporation of New York City, and due credit should have been given for the use of said photographs. We now wish to give due credit, overlooked in the September issue of the former MONTHLY.

Tests of Rubber Goods

JUDGING by correspondence and visits received by the Bureau of Standards, the greatest interest is shown by many persons and industries in the testing of rubber goods. Circular No. 38 of the Bureau of Standards on this subject was issued several years ago. The fourth edition of this circular, for sale at 20 cents per copy by the Superintendent of Documents, Washington, D. C., will soon be issued and describes methods of physical and chemical testing of rubber goods employed at the Bureau, classification of the materials used in compounding rubber for various uses, and a short description of the method of gathering crude rubber.

As the testing of fabrics used in the manufacture of rubber goods is very important in some industries, this work is likewise treated in some detail, and an appendix contains a list of governmental specifications as well as a bibliography of the papers published by the Bureau and some important books and periodicals that deal with rubber.



1. Aluminum sulfate 2. Ferric chloride 3. The sugar-copper "plant" 4. Nickel nitrate

Artificial "chemical cells" which exhibit the osmotic phenomena of living and growing plant organisms

Artificial Plants in the Making

The Study of Osmosis Under Natural and Artificial Conditions

By Dr. E. Bade

THE question whether the herring is salty because it inhabits the ocean cannot be answered with a direct yes or no. The salt content of the blood in various fish varies with the species and the locality inhabited by it, the concentration being generally the same as the osmotic pressure, but it is not invariably so. In the blood of the shark it is equivalent to the osmotic pressure, in other fish it is much lower. But other complications arise. The various parts of the body of an individual do not have the same constant pressure nor the same concentration of salt. The glassy fluid of the eye is here much richer in salt and has a higher osmotic pressure than the blood. The fluid in the body cavity is saltier than that of the blood, but the flesh has a much lower content of salt than both.

But animals are not entirely placed under this influence. The eggs, and the young of some fish, which in their early stages are soft of body, delicate, and fragile, and carried about the ocean like plankton, possess a much lower concentration of salt, their osmotic pressure being minimal. The same is true of other animals, notably salmon and eels, etc., which are able to live both in fresh and salt waters. But here the animals must pass a certain time in brackish water so that part of the salt in their blood can be withdrawn into the water before they pass on. If the salt content is not gradually decreased, the animal dies, the cells being incapable of resisting the sudden change of osmotic pressure.

A somewhat similar relation is found to exist in the vegetable kingdom. Plants, through their root hairs, absorb not only moisture but certain salts which are necessary for their existence. These are taken up by the process of osmosis. When the water in which the salts are dissolved passes through the membrane of the cell, it naturally creates an internal pressure, and since the membrane, which is semipermeable, allows water to enter, but does not allow it to pass out, the internal pressure must come to equilibrium. This is arrived at when the pressure of the cell content and the absorbing power of the plasma membrane are equal. These turgid cells do not, of themselves, produce a rise or flow of sap. The water is pressed from cell to cell by infiltration since the infiltrating resistance of the plasma membrane varies with the pressure exerted upon it. But in this second cell osmosis also plays its part. In this way the sap is carried from cell to cell toward the conducting tissues.

If now a plant is cut a short distance above the soil, sap will soon be noticed exuding in the form of drops. At times the quantity of water thus given off is exceedingly large. Certain species of Cissus of Java, vine-like plants, are considered vegetable wells. The relatively cool and wholesome liquid exuded soon fills a cup. Drinkable sap is also supplied by Araliazea and others. When Agave Americana, the century plant, is cut horizontally, 365 grams of sap will flow in 24 hours, and more than 2500 grams in one week. This is the plant used by the Mexicans for their "national" drink, pulque.

The pressure under which the sap is exuded under these conditions is called root pressure and it is measured by attaching a bent glass tube exactly upon the stump of the cut surface and filling the tube with mercury. The pressure thus exerted is greatest near the soil and gradually decreases with the height. But this pressure is never the same for each hour, and varies considerably during the year. Under favorable conditions, *Ribes rubrum* (currant) develops a pressure of 358 millimeters of mercury; *Acer platanoides* (Norway maple), gives 347 mm.; *Acer saccharum* (sugar maple), 1033 mm.; *Psedera quinquefolia* (Virginia creeper), 615 mm., and *Vitis vinifera* (European grape) 860 mm. The European grape exudes one liter of sap in 24 hours, while the sugar maple exudes as much as 5 to 8 liters in the same time.

Each cell, with its concentric layers of membranes and fluids, is an osmotic system. The higher plants, consisting of innumerable cells adjoining and touching, make up osmotic system upon osmotic system, at least in the roots, until the sap has reached the central cylinder where other forces and factors aid in the distribution. The lower plants—the salt water algæ, the mycelium of some fungi, etc.—consist of but one cell.

A somewhat similar simple cell or osmotic system can easily be reproduced artificially. Such a man-made plant, while not possessing the vital spark of life, is susceptible to chemical and physical stimuli, and its development is hindered by poisons. Just like the living plant, these artificial plants are able to heal wounds caused in the course of growth; and since the nutritive liquid must rise a considerable distance, these products must be provided with canals for the rise of the "sap," if we may borrow the term for this use.

The power of osmotic pressure, in such a simple chemical cell, is most conveniently observed by introducing a tiny crystal of cobalt nitrate, manganese sulfate, ferric chloride, nickel nitrate, or aluminum sulfate into a solution of two parts of water glass (sodium silicate) and one part of water. Here the solution is separated from the crystal by a so-called semi-permeable membrane. After a few seconds it is noticed that the system is not in equilibrium. Water passes through the membrane into the crystal. The latter dissolves and produces a pressure between the liquid within the cell and the outside liquid; and this causes an expansion. Here the change is in the direction of equilibrium, and the osmotic pressure is satisfied when water will pass neither into nor out of the cell.

Various kind of plantlike structures can easily be produced with these and similar chemicals. If one part of water glass and six parts of water are used as the liquid, we may use seeds made by mixing 15 parts of copper sulfate, 5 parts of ferrous sulfate, 5 parts of calcium sulfate, and 5 parts of water. These must be dried after making the seeds about the size of a pea. These will produce green moss-like structure. Brown algæ-like shapes are got from seeds made by mixing 15 parts of ferrous sulfate, 5 parts of copper sulfate, 5 parts of calcium sulfate, and 5 parts of water. For tree-like and bushy vegetation having green stems and white branches a mixture of 10 parts of manganese sulfate, 10 parts of copper sulfate, 1 part of ferrous sulfate, 5 parts of calcium sulfate, and 2.5 parts of water are taken.

Another way in which beautiful plant-like structures can be obtained is by making seeds consisting of one part of copper sulfate and one part of sugar and placing them in an aqueous solution consisting of 100 parts of water, 10 to 20 parts of a 10 per cent solution of gelatine, 5 to 10 parts of a saturated sodium chloride solution, and 10 to 12 parts of a saturated solution of potassium ferro-cyanide. The development of the artificial plant occurs according to the temperature, sometimes requiring a few days and sometimes only a few hours. Here the artificial seed first surrounds itself with the permeable membrane of copper ferrocyanide which permits the entrance of water, but does not allow the sugar to escape. Because of this partial permeability, pressure is exerted within the seed which produces growth throughout the entire system. If the fluid is placed on a glass plate, growth occurs in one direction only; if it is brought into a deep vessel, the structure grows both horizontally and vertically. Then true stems are formed, which, when they reach the surface of the liquid, spread out like flat leaves. These artificial structures develop protuberances shaped like spheres or seed-pods, mushroom-like structures, and so, outwardly, resemble the organic forms.

A chemical flower garden of diverse origins

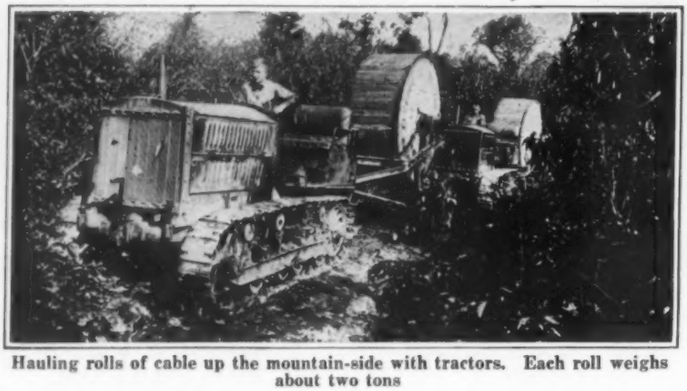
The Lincoln Highway of the Telephone

The Romance and the Technical Difficulties Met in Laying a Giant Cable Across the Mountains of Pennsylvania

By Harry A. Mount

AN epoch in the art of communication will be marked by the completion of a 200-mile stretch of telephone cable over the mountainous country between Pittsburgh and Harrisburg. This stretch, coupled with the cable already in use between Boston, New York, Philadelphia and Harrisburg will be the longest overland cable in the world—and more. It will bring to a successful conclusion an engineering venture of the first magnitude, which ten years ago would have been impossible.

For this cable differs from the better-known ocean cables in important respects. The latter contain but a single metallic link between the continents, whereas the land cable contains within a sheath of lead scarcely larger than a man's wrist nearly 300 telephone circuits and over 175 telegraph circuits. The patient research, the ingenuity and the engineering skill which have made this possible seldom have been matched. The physical difficulties of laying a great cable over pathless mountain-tops are scarcely less to be wondered at.



Hauling rolls of cable up the mountain-side with tractors. Each roll weighs about two tons

It is hard for the average man, whose knowledge of the intricacies of the telephone begins and ends with the instrument on his desk, to realize that the investment in this cable, mile for mile, is of the same order of magnitude as that in a railroad. But consider these facts: the cable used in this 200-mile stretch weighs about 4000 tons and is spliced together from 2000 sections. The work of splicing took about 20 tons of solder, 15 tons of paraffin, and 7000 square yards of muslin. The poles that hold up the cable number 10,000, and the wires within it, if joined end to end, would stretch 163,000 miles. In addition, at intervals of 50 miles, there are repeater stations which house the costly and complicated apparatus necessary to the operation of the cable. Every 6000 feet there is a big iron pot containing "loading coils," one for every circuit.

This new cable is a unique achievement, not because it carries a large number of wires or because the cable itself is any different from those already in use, but because it marks the first successful application of what is known technically as a fine-wire cable to long-distance communication. The largest conductors within the cable are five-hundredths of an inch in diameter and these are far out-numbered by the remaining conductors which are but slightly greater than three-hundredths of an inch in diameter. Considering circuits of equal length, the installation of this cable effects saving in copper of four and one-half times over the hitherto best type of long distance cable.

At one point under Broadway, in New York City, for telephone communication alone, there are 35 cables, containing a total of 47,000 wires. This vast number of wires, if placed on a single overhead line, would require poles two miles high, or if the poles were only as high as the Woolworth tower, twelve lines would be required to carry them, and the street would be literally roofed over with a canopy of copper. As regards telephone communication, this is perhaps the most congested spot in the world. Of the 26,000,000 miles of wire owned by the largest telephone company, about 15,000,000 miles are now in cables, valued at $300,000,000.

A somewhat similar congested condition is arising in certain of the long-distance lanes of communication, and the recently developed type of cable meets the needs of the situation. At the present time three full pole lines are required to handle long-distance telephone traffic in and out of Pittsburgh to the east. The rights of way followed by these lines provide no further facilities for more open wire circuits, and the topography of the country is such that no more routes suitable for economical construction are available. It is estimated that the 175 circuits now used along this route must be doubled within the next ten years. It is just such a situation as the cable was developed to meet.

The first telephone cables were laid under the streets of Boston, and although carrying only about twenty circuits, were extremely inefficient. Not only was the quality of the conversation very poor, but because of electro-static relations within the cable, conversation had a tendency to leak into neighboring circuits, and it made very little difference whether the receiver was attached to the same pair of wires as the transmitter, or to any other pair. In fact, it appeared for a time that the cable would be quite impracticable if more than a quarter of a mile long. In 1889 a few short cables two inches in diameter and carrying a hundred wires were used with encouraging success. Since then their use has steadily increased and improvement has taken place until some of the cables under our city streets, while only two and five-eighths inches in diameter, carry 3000 wires.

Aside from the fact that open-wire lines occupy too much space for congested city streets, they have other inherent shortcomings, chief of which is the liability to interruption of service from sleet and wind storms, and other adverse weather conditions. With the idea of making the important circuits between Washington, New York and Boston as secure as possible from storms, an underground telephone cable was built to connect these cities several years ago. It has given satisfactory and uninterrupted service since its opening in 1913. But the cable itself and the copper wires within it were of very heavy construction and consequently very expensive.

The approaching need just pointed out for the extensive use of long-distance cables was realized several years ago by the engineers who have developed the nation's long-distance telephone service. Accordingly, development work was instituted with the object of determining whether fine wire toll cables could be placed on an equal footing commercially and economically with open wire toll lines. The outcome has been many important contributions to the art of communication, among the more important of which may be mentioned four-wire repeater circuits, a totally new type of telegraph system employing full metallic circuits, special loading coils and phantom repeating coils, and a new type of signaling system for circuits which carry telephone and telegraph messages simultaneously. These are but a few of the developments which are contributing directly to the successful operation of fine-wire toll cables.

Where the cable dips across the valley east of Bedford, Pa. In the insert is shown a loading coil on the hilltop

It is one thing to establish satisfactory communication over a fine-wire cable within the limits of a city, and quite another to talk over hundreds of miles of such cable. The electrostatic capacity between two parallel wires even when held several inches apart on an open wire circuit is considerable when stretched for hundreds of miles, and when these wires are placed close together within a cable they become a condenser of large capacity. A telephone current starting out over these wires charges and discharges this "condenser" rapidly and at each successive charge the original current becomes weaker. Within a very few miles the current has dwindled away until it is no longer perceptible.

This condenser effect is partially overcome by placing loading coils in each circuit, size of and distance between which are carefully determined in accordance with the electrical constants of the cable. This is simply a highly efficient form of inductance and serves to neutralize the effects of capacity between the wires. A loading coil consists of a core of compressed iron dust, the grains of which are held together by a small amount of binder. In the simplest type of coil, the core carries two windings, one winding being placed in each wire of the circuit. The loading coils must be protected from all moisture, and to this end they are packed in large cast iron pots which are sealed shut.

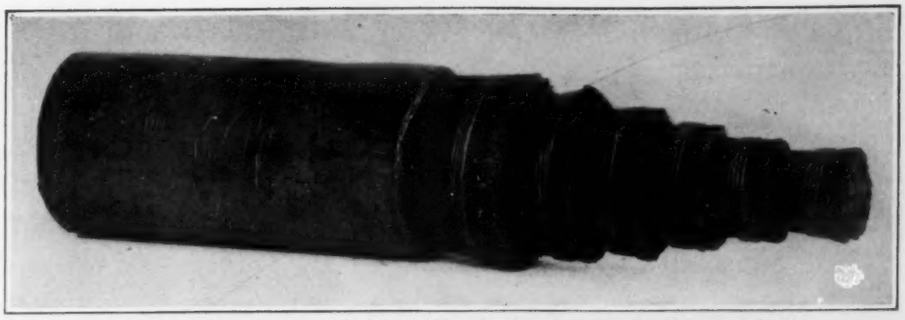
In spite of the fact that loading coils are used, the current "peters out" or is rapidly attenuated as it traverses the cable, and before reaching the end of any but the shortest circuits would become

too weak to operate a telephone receiver satisfactorily. To restore the attenuated current, repeaters are inserted in the cable every 50 miles. These repeaters are in reality vacuum tube amplifiers, somewhat similar in principle, but different in design and construction, to those used in radio work. But they are especially designed to meet the rigid demands of steady and efficient telephone service. One of the requirements of the telephone repeater is that it amplifies all of the many hundreds of frequencies in the human voice equally, that is, without the least distortion. It is comparatively easy to amplify a voice current once and to get a good result, but when the current must be amplified again and again, as in long-distance telephony over a cable, if the slightest distortion were present in each repeater it would grow with each successive amplification until the final result is entirely unintelligible. Suffice it to say the desired result is now accomplished, not occasionally but every time, so that a voice transmitted over a thousand miles of cable is quite as distinct as though the speaker were in the next building.

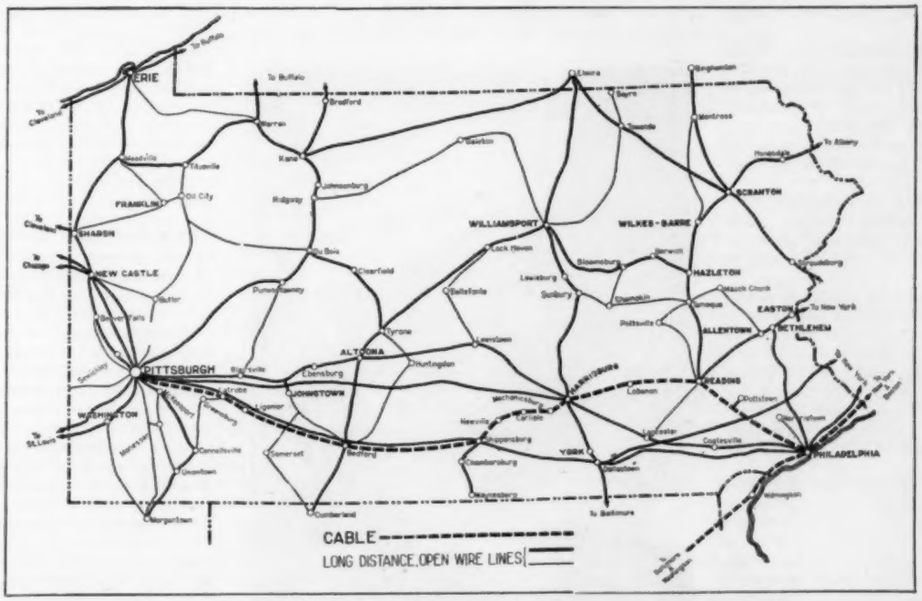
This was not the only engineering problem to overcome. There was the problem of "cross talk," that is, the induction of a current in all adjoining pairs of wires and the consequent spreading of the conversation which so baffled the early experimenters. That difficulty was overcome in a simple but ingenious and highly effective way. Each pair of wires is twisted together with a different pitch; thus one pair may make one twist in 12 inches, the next in 15 inches, and so on, so that the wires of adjacent circuits are "balanced" with respect to one another. This twisting is done by the giant machine which makes the cable. Hundreds of wires are fed together by this machine to form the complicated core of the cable which is then carefully baked. From the oven it passes directly to a heavy hydraulic press which molds a sheath about the core from a mass of solid lead. The lead sheath is really an alloy, for it contains about one per cent of antimony to give it certain desirable qualities. About 3 per cent tin was formerly used, but the antimony has been substituted at a great saving and with an improved result. The insulating material used in the cable has been the subject of a great deal of study. The material finally adopted is a thin, tough paper made from manila fiber. Worn-out manila ropes were found to be ideal for the purpose and practically all of the old rope from ships which was once thrown away now goes into the making of telephone cables.

As a matter of fact, although the line is practically completed and ready for service, engineers are still busy with investigations relating to it. One of these seeks to determine the effect of interference from electrical power lines which cross or parallel the cable.

Our illustrations show, more clearly than words can describe, the physical difficulties of installing the great cable. Construction was comparatively easy where the right of way paralleled highways or followed old lines, but in places the telephone engineers had to make their way through a veritable jungle, where it was impossible even to walk without first cutting a path. Great reels of cable, each weighing more than two tons, had to be rolled and dragged to isolated mountain tops far from a highway. Caterpillar tractors solved this problem. There were not only mountains and valleys to be crossed, but rivers to bridge. As shown in one of the photographs, the cable parallels the open wire telephone line running from Philadelphia to Chicago, which it is expected will be partially dismantled as soon as the cable is in complete operation. The section of cable between Pittsburgh and Harrisburg is but one link of an installation which is being pushed rapidly further west and which will ultimately mark a new epoch in telephone service from Chicago, Toledo, Cleveland and other cities of the mid-West to the cities of the East.



Section of a long-distance telephone cable, showing arrangement of layers of wire



The route of the big 'phone cable across Pennsylvania, and its connections

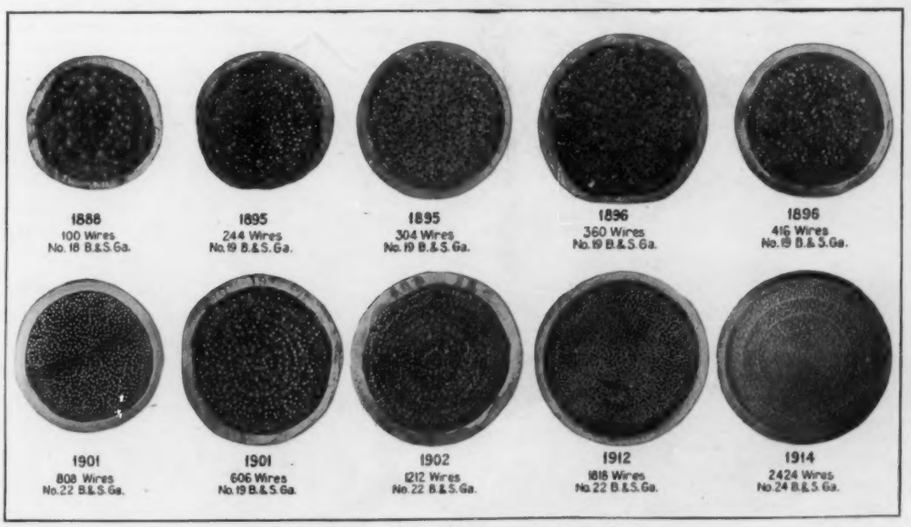
Measuring the Growth of Trees

IN the *Proceedings of the American Philosophical Society* for August, 1921, Dr. D. T. Macdougal gives the results of observations, made with a dendrometer, on the growth of trees. It was found that the period in which enlargement of trunks takes place is comparatively brief even in places in which the season is of indeterminate duration. Growth is an activity of an embryogenic tract of tissue, the activity of which depends upon environmental conditions, and no part of the observations suggested a sensonal rhythmic action.

The trunks of all the trees measured show a daily variation in size, by which the maximum is reached shortly after sunrise and the minimum at a time after noon, dependent upon external agencies. These variations appear to depend upon the water-balance in the woody cylinder, are greatest in the seasons in which water-loss from the crown is greatest, are least in the cooler or damper seasons, and are to be detected in the records even in the period of most rapid enlargements of the trunk. The trunk of a tree may, in fact, be compared to the supply hose of a fire engine coupled to a hydrant. When the pressure from the mains is enough to supply water faster than it can be pumped out, the hose is distended. When the engine tends to take water faster than it would be delivered by the system, the hose would tend to collapse. Something of this sort takes place in many trees which have been kept under observation. The conduit in this case, however, is not a simple pipe or a set of pipes, but is made up of vessels through which water may pass under capillary conditions, and enclosed box-like tracheids which may be only partially filled with water. When water is withdrawn from such a system faster than it is taken in the resulting changes in form and size are complex in character, but are expressed by the well-defined daily equalizing variations which are of a characteristic type for each kind of tree.

Awakening and growth of the terminal buds with resultant elongation of leaders and branches generally begins some time before enlargement of the trunk takes place in many trees. The period separating the two may in extreme cases be no more than a week.

The fact that growth depends upon physical conditions largely external instead of being a manifestation of a rhythm on the part of the tree is well evidenced by tests in which trees which had ceased to grow with the seasonal drying out of the soil were awakened by the introduction of a renewed water supply.



How cable capacities multiply as time marches on

The Yacht of a Viking Queen

By Charles d'Emery

THE mere mention of the word "Viking" carries with it visions of the daring navigators of the North, the men of Thor and Wodin and other gods of the Northland: and after one has sailed through the magnificent scenery of the fjords and felt their overpowering ruggedness, seen their sheer black walls of rock rising from the emerald depths of unruffled waters to their snow-covered tops thousands of feet above, one tries desperately to recall visions of those days when the fanciful prow of the Viking ships glided swiftly through these blue-green waters, impelled by rhythmic stroke of two-score oars in the hands of weather-beaten men, helped along perhaps by a huge square sail.

Copyright, E. M. Newman

Unearthing the Oseberg ship, a Viking relic from the eighth century

Viking days are, comparatively speaking, quite recent. It is less than a thousand years ago that Eric the Red crossed the North Atlantic. Many of the classic sagas of the Icelanders are of a much later date; yet there is very little left of these Norsemen that would give us a clear picture of their early days, and what there is has been carefully put together and preserved by the Norwegian Government.

In our own land we have relics of the ancient cliff-dwellers dating back several hundred thousand years, but it is a long way from the dry, clear atmosphere of our southwest to the rain and fog, wind and cold of Norway.

Under more favorable conditions we would, no doubt, have a great deal of material that would enable us to reconstruct much of the ancient life, for it was one of the Viking customs to bury their prominent dead in a ship which was sunk in the earth and covered with a mound. Within these burial ships were placed the choicest belongings: horses, carts or wagons, sleds, apparel, cooking utensils, and quite often a living servant accompanied the master to the grave to minister to his wants in the halls of Walhalla.

It is only through a fortunate circumstance that there are any relics of this kind in existence, and that is due to the fact that in several cases the ships were buried in potters' clay, which is particularly good for the preservation of wood. Under ordinary circumstances these burial boats have been totally destroyed by the dampness of the earth, only the rotted rivets gave any clew as to the size of the boats.

To date only three such boats have been found that could be reconstructed; the last one was found quite recently, and it has proven to be the finest of the three. It is known as the "Oseberg Ship," being unearthed in the place of that name in the province of Jarlsberg and Larvik.

The ship was buried in potters' clay and the mound was built of peat, which formed an almost hermetic covering, thereby preserving all of the perishable material. Even the traceries and carvings upon the stern and bow of the ship were untouched by the ravages of time. In the center of the ship was a well-built sepulchral chamber filled with numerous articles. Feminine appliances of all kinds; spinning wheels, a loom for weaving, four sledges, several beds, a millstone, kitchen utensils, oak chests, feathers and down from pillows, balls of thread and wax.

In the midst of the sepulchral chamber were the remains of two females; one of them the distinguished woman who was thus royally buried, and the other probably that of the maid, who had to accompany her mistress in death.

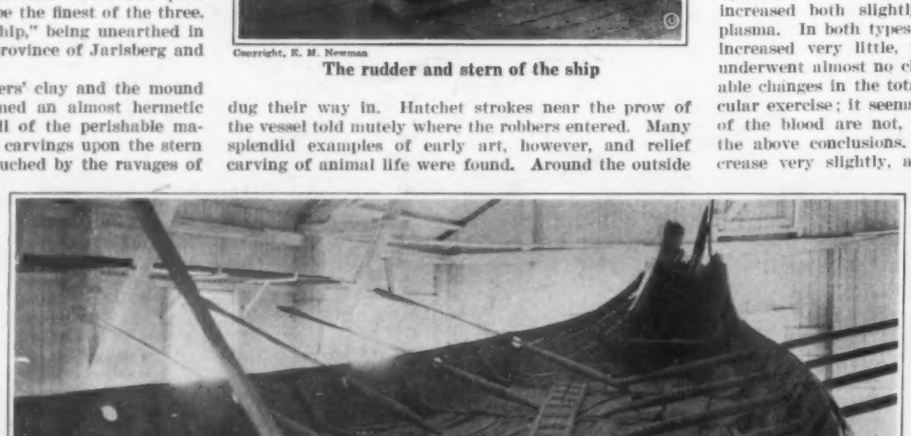
Valuable ornaments were missing, and perhaps a great many other interesting things also, for the greater part of the chamber seems to have been removed by robbers, who had dug their way into the mound many centuries ago; fragments being found in the section of the ship where they had dug their way in. Hatchet strokes near the prow of the vessel told mutely where the robbers entered. Many splendid examples of early art, however, and relief carving of animal life were found. Around the outside of the ship were many skeletons of horses, oxen and dogs that had been killed to accompany the body of the distinguished woman.

Copyright, E. M. Newman

The rudder and stern of the ship

The ship is 71 feet in length, 16½ feet in breadth and built entirely of oak. There are holes for the oars in the upper strakes, 15 to a side; there is also an appliance to hold the mast firm. The mast is set into the keel, but a large beam that runs across the ship close to the mast has been highly arched in order to form a higher and firmer support. The rudder is fastened by an osier band, and the rudderhead is kept in the gunwale by a skillfully plaited rawhide band. The ship is rather flat bottomed, with a very fine sheer, giving the impression that she was mainly used as a pleasure boat in the fjords.

The age of this ship has been placed at about 1100 years, judging from the ornaments and carvings found within the sepulchral chamber. It was carefully unearthed, and reconstructed bit by bit, for some of the ribs had to be steamed in order to restore its original form. It took nine months to complete this work, and the finished boat is now on exhibition at the University Museum of Christiania. All of the numerous contents may also be seen in one of the other Museum buildings there.



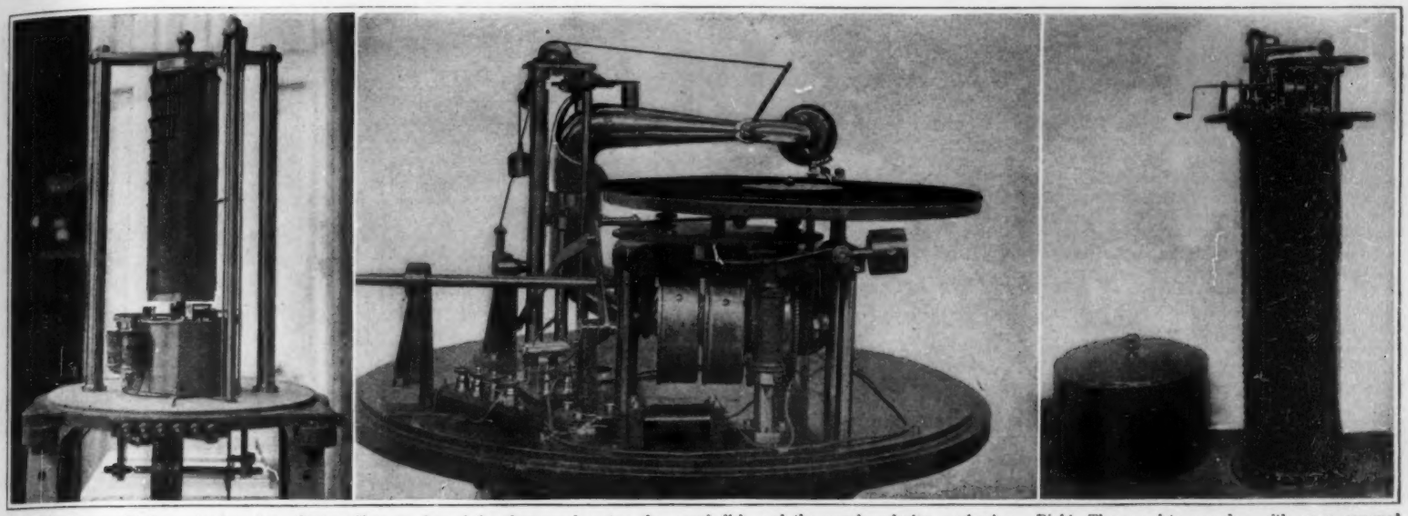
Copyright, E. M. Newman

A section of the bow of the burial ship, showing the original gangplank

The Effect of Exercise on Blood Constituents

THE *Journal of Biological Chemistry* (London) for August, 1921, contains an account of investigations made by Dr. N. W. Rakestraw of Leland Stanford University on the effect of muscular exercise upon certain common blood constituents. The investigation was undertaken on 21 human subjects to determine the changes produced by severe muscular exercise upon the following constituents of blood and plasma: Non-protein nitrogen, urea, sugar, uric acid, preformed and total creatinine, cholesterol and hemoglobin, as well as specific gravity, viscosity, and the number and relative volume of corpuscles. As a result of his investigations the author finds that short, strenuous exercise invariably increases the blood sugar concentration both in plasma and corpuscles, while a longer period of exercise is generally accompanied by a drop in blood sugar, which was greater in the plasma than in the whole blood. Both kinds of exercise were accompanied by a small increase in uric acid, of about the same order, which was greater in the plasma than in the whole blood. Short, strenuous exercise had no effect upon urea or non-protein nitrogen, but longer work increased both slightly, in whole blood as well as plasma. In both types of exercise the total creatinine increased very little, while the preformed creatinine underwent almost no change. There were no considerable changes in the total blood volume during the muscular exercise; it seems variations in the concentration of the blood are not, therefore, disturbing factors in the above conclusions. Cholesterol was found to decrease very slightly, although results were not thoroughly consistent. The decrease seemed to be somewhat more noticeable in the corpuscles than in the plasma. The specific gravity, hemoglobin, and the number and relative volume of corpuscles were found to increase during the periods of exercise. The viscosity of the whole blood was found to increase considerably and that of the plasma slightly during exercise.

Some of the results obtained suggest that the total nitrogen is increased in the blood by exercise, and that urea, non-protein nitrogen, and uric acid continue to increase for some time after a work period, while the sugar concentration, on the other hand, returns to normal within two and a half hours after exercise.



Left: The drum, with its projecting pins. *Center:* Close-up view of the phonograph motor, the record disk, and the sound-producing mechanism. *Right:* The complete recorder, with cover removed

Water-level recorder that speaks out and informs the engineer audibly of its findings

A Recorder That Speaks

IT is a matter of daily routine for engineers in charge of water-supply reservoirs or hydroelectric stations to have to ascertain at a few minutes' notice the state of the water-level of some distant and perhaps difficultly accessible tank or reservoir. To help them in this work there have been adapted from instruments in use in chemical works, etc., certain warning systems whereby an alarm is sounded on the water reaching certain levels. These systems presuppose that the person interested is within earshot of the alarm, and also expecting it. Should he be absent, or preoccupied, and fail to hear the alarm, serious effects might ensue.

To obviate this there are a number of level-indicators which can transmit a record of the level of a water supply or other variable to any distance from the instrument itself. But it is a fault of these that it is necessary not only to install special receiving instruments at any point where a record is desired, but private wires as well. To overcome this difficulty a new type of audible recorder has been developed which necessitates no other apparatus additional to the transmitting instrument. This is allotted an ordinary telephone number, and can be connected with any telephone on the ordinary exchange. Thus the engineer or superintendent, wherever he may be, in his office or in town, can call up at any moment to far-off and inaccessible reservoirs (maybe among distant hills) and receive at once audible notice of the quantity of water in the reservoir, well, etc. The information is received direct, without the intervention of any human agency, thereby minimizing the possibility of error.

Two types of instruments are made. In the first a float on the surface of the water moves a cord attached to the instrument. This cord raises or lowers a contact arm fixed near a vertical drum. This drum, as will be seen from the figure, somewhat resembles the selector gear used in automatic telephone exchanges. At 100 different distances from the bottom of the drum, corresponding with 100 different levels of the water from 1 foot to 100 feet, are pins projecting from the surface. When the instrument is "called up" from the exchange in the usual manner the drum commences to revolve, and the contact arm comes in contact with the pins projecting from the surface of the drum. A special selecting gear is provided to ensure that once the machine is in motion the arm can not alter its position until the revolution of the drum is complete. Each pin as it meets the contact arm causes a loud "click" in the telephone circuit. If, for instance, the water level stood at 45 feet, the engineer would actually hear clicks in the sequence:

— — — — — — — — —

This signal is repeated three times by the instrument, to obviate any possibility of mishearing. When it has been thus repeated the telephone line is automatically cleared, and the instrument is again ready to be called up as and when required.

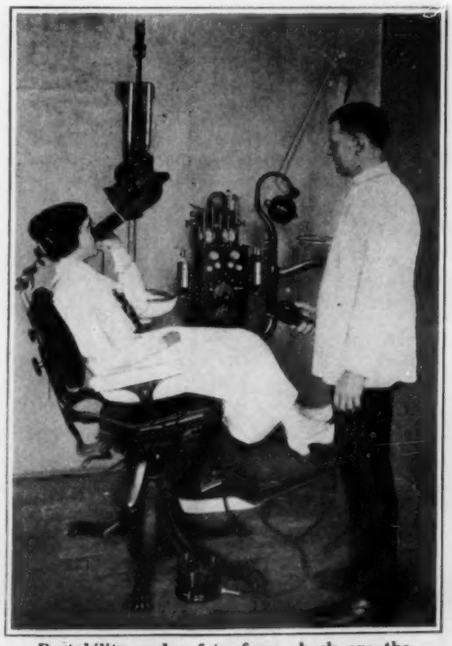
Another form of the same apparatus has been designed, so as to give the actual reading in spoken words. This form consists of a gramaphone mechanism working in conjunction with the level-recording gear. As the level changes, the needle and sound-box of the gramaphone are moved over the record. The latter is "vocalized" in 200 concentric circles, and when the instrument is "called up" the needle is depressed on to the circle on the record which corresponds to the water-depth. The instrument reads from "empty" to "one double nought" by halves. If the water level were 42 feet, the engineer on calling up the instrument would hear a voice say:

"Four two—four two—four two—etc." This would be repeated eight times, to ensure that there should be no mistake. Half feet are recorded, 42½ feet being vocalized as:

"Four two half—four two half—etc." A special type of needles made of alloy steel is used, so that one needle serves for two thousand calls.—*By F. A. Rowlinson.*

The Friction and Carrying Capacity of Ball and Roller Bearings

TESTS, originally requested by the Navy Department, have been conducted by the Bureau of Standards, on the maximum safe load and static friction under load of ball and flexible roller bearings. The tests were quite exhaustive, and included balls, rollers, and races of different sizes and hardness. The results have been collected in the form of Technologic Paper No. 201 of the Bureau of Standards, obtainable from the Superintendent of Documents, Washington, D. C., at 10 cents per copy. This paper should be of value to anyone interested in the design and use of these important types of bearings.



Portability and safety from shock are the features of this X-ray apparatus

An X-ray Outfit in a Hand-Satchel

FANCY a complete X-ray machine in a single unit the size of a portable enclosed typewriter. Imagine a dentist or doctor carrying it to the bedside of a patient and working it from an electric light socket. Or a contractor locating hidden wiring and metal construction in walls and floors with it. Whereas one of the smallest X-ray machines built before weighed 150 pounds and was in four units, this new machine is in one small steel can with bakelite cover and weighs 20 pounds.

But aside from its small size the apparatus has another virtue not possessed by its predecessors. Danger to both patient and doctor from contact with high-tension wiring is completely eliminated by enclosing the tube, high-voltage transformer and stabilizer within this little oil-filled metallic case which comprises the the complete unit. The presence of this machine in the scientific world has just been announced by Dr. W. D. Coolidge of the Research Laboratory of the General Electric Company.

The new midget was built experimentally not merely to give the world a tiny X-ray machine, but to remove the element of danger from electric shock which has always attended the use of even the most modern X-ray apparatus. And it has been successful.

In order to protect against this ever-present danger the idea was conceived of putting the transformer and the tube inside a metal case and immersing them both in oil. Thus there are no high-tension leads to contend with. A wire carrying house-lighting current—usually 110 volts—runs from the lighting circuit to the X-ray unit and the transforming is done inside the case.

In order to make this unit most effective for dental service it was necessary to swing it at the end of a folding arm. Necessarily it had to be small, so the size of the former types of transformer for X-ray use was reduced by about 50 per cent and the tube was reduced from 15 inches to 5¾—and other ingenious changes were made in the apparatus so that the whole unit was brought down to 20 pounds.

The two types of apparatus undergoing development include a 60,000-volt unit for heavier work and a 40,000-volt machine for lighter work. The 60,000-volt unit is supported over the operating table by a stand similar to that used for the ordinary X-ray tube, but which permits easy movement of the whole unit. Neither the tiny 40,000-volt machine nor the heavier 60,000-volt unit is adapted to X-ray treatment of disease. But they are effective for general radiographic work and they are absolutely safe, electrically.

Tuolumne Canyon 4000 Feet Deep

TUOLUMNE RIVER rises in a group of glacial lakes on or near the Sierra divide in California. The river flows through beautiful upland meadows in its upper part and then through a canyon, nearly 80 miles long, which it has cut in solid granite. For a distance of about 25 miles, according to the United States Geological Survey, Department of the Interior, the upper part of this canyon is 3000 to 4000 feet deep and is known as the Grand Canyon of the Tuolumne. At the lower end of this canyon lies Hetch Hetchy Valley, which is smaller than the Yosemite Valley but resembles it very much in every other way.

The closest photograph ever made of Mount Everest, taken from a near-by elevation of 22,500 feet

The Mount Everest Reconnaissance

Further Details of the Effort to Locate a Possible Route to the Top of the World

UNDER this heading we summarized in our January issue the official information reaching us from the Mount Everest expedition. The mountain had been practically circled, and the closest scrutiny had failed to discover a possible route to the top; now, however, there is a different story to tell. A promising path was found on the northeast scarp, and members of the party climbed it to within 6000 feet of the summit, only a series of violent storms preventing them from going higher. Even though the resumption of the attack next season fails of reaching the apex, the undertaking has, from the scientific point of view, richly repaid all efforts. One life was sacrificed to the cause; Dr. A. M. Kellas had laid the party under a debt of gratitude for his knowledge of Himalayan travel and of the capacities of the native porter. Worn out by previous exposure, he succumbed to the strain on June 5th, at Kampa Dzong.

Mount Everest, towering 29,000 feet above sea level, perpetuates the name and work of George Everest, whose genius planned and largely carried out the survey of India; it is particularly associated with that staggering geodetical feat, the measurement of an arc of the meridian on the great arc series of triangulation covering 1500 miles from Cape Comorin to Banog. This triangulation is now being extended to the north and will conduce to a truer conception of the figure of the earth's crust and of the irregularities that cause the plumb line to deviate from its normal direction. The season's work of the present expedition includes the mapping of more than 13,000 square miles of hitherto unknown and difficult country, with a photographic survey, one inch to the mile, of the whole Everest group; the geology of the district has been thoroughly investigated, and the long-guarded secret of the age of the Himalayas has been read in the fossils found. A huge collection of seeds is being brought from the valleys, many of which are doubtless new.

The return journey to Darjeeling led ten miles up the Arun valley, and followed the Kaichu for four miles to Lumeh; the poplar bridge here had been washed away, but the low waters were easily forded, and camp was pitched. Resuming the journey, a short but precipitous climb led to the Cuckoo Pass, avoiding an impassable gorge. Six miles beyond was encountered the famous rope bridge, stretched between two twisted tree trunks anchored in piles of boulders. Passengers and baggage travel on a piece of wood pulled back and forth along the ropes. Midway across the stream, the ropes sagged so that the luckless passenger was sitting in the cold water, and the Tibetans thoroughly enjoyed the practical joke of holding the coolies of the party at that point until they were drenched by the waves and shivering in the chill wind. It took half a day to complete the crossing. Long marches brought them by way of Gyanganangpa, across the Tinki Pass, to Tinki Dzong. Through blizzards, with the thermometer at zero, crossing spurs 17,000 feet in height, the party pressed on to Darjeeling, which was reached on October 25th. Gen. C. G. Bruce will lead the expedition this year, starting in March, in place of Col. Howard Bury, who was unable to resume the leadership this year.

This summary would be incomplete without mention of the "wild hairy men" and "human footprints" that have been headlined and exploited by the newspapers. On the slopes of Everest the expedition encountered footprints of apparently human origin. Some authorities account for these by the fact that this district is known to harbor a large species of monkey, the hanuman or lunger; being omnivorous, it could find plenty of food there. However that may be, the Tibetans firmly believe in a race of wild men existing on the slopes of Everest, Chumalhari, and Karola; the coolies describe them as clothed only in their own hair, with feet turned outward. The only instance of a white man's glimpsing one of these "Abominable Snow Men," as the natives call them, is that brought forward some years ago by William Hugh Knight, of the Royal Societies Club. Near Gantok he found himself alone on an open clearing, the rest of his party having pushed on ahead, where he stopped to breathe his horse. Turning at a slight sound, he saw a formidable figure some 20 paces away, gazing down the hillside. Mr. Knight describes the wild man as pale yellow all over, almost stark naked in spite of the bitter cold of November, with a shock of matted hair, highly splayed feet, and large hands, one of which held a crude bow; he had the muscular development of a gorilla. The figure soon disappeared down the hill, running at incredible speed. It should be said that the Tibetans drive their murderers into desolate places and forbid them any communication with law-abiding communities; it is within the bounds of possibility that the footprints seen by members of the Everest expedition, and the individual seen by Mr. Knight, may thus be accounted for.

Left: The northeast scarp of Mount Everest and its environs, showing the point (A) to which the expedition penetrated and from which a practicable path to the summit is believed to exist
Right: The mountain from a point on the Rongbuk Glacier, about seven miles distant. This shows Everest from the north, where it is absolutely impregnable

Mount Everest from two angles, showing where it may and where it cannot be climbed

The Physical Basis of Heredity

Dominant and Recessive Characteristics: How They Arise and How They Work

By Prof. James B. Kelly, Pennsylvania State College

ONE must regret the ease with which a matter-of-fact attitude is assumed toward the truly wonderful things of our environment. Lists of the leading wonders of the world will include some large heap of stones in Egypt or some mechanism for utilizing nature's forces, but will ignore such a really marvelous fact as the fact of heredity. Professor Brooks used to induce his readers to confer a proper emphasis upon heredity by having them first consider the complicated machinery of a modern steamboat and the nicety with which all parts work together for the propulsion of the whole. It is all very impressive. But then, he would add, suppose that it should be found while the boat was being studied that small bits of iron, without structure, are from time to time broken off and thrown overboard and that each of these contains within itself the power to build up all the machinery and appliances of a steamboat as perfect as the original—this would be like the phenomenon which is brought before the thoughtful in the word heredity. Every plant and every animal, including man, starts existence as a relatively simple particle—a cell—that has not even the remotest resemblance to the adult that it will produce. Nevertheless, through this reproducing particle, traits (or the factors that condition them) are carried on with remarkable certainty.

Now it is well known that the bodies of the higher plants and animals are really each a great group of cells cooperating for the benefit of the whole. The group had its beginning in the single cell already referred to as the reproducing particle. Structurally this single original cell resembles any other cell. It contains protoplasm, a white-of-egg-like substance with a machine-like structure. The portion of the mechanism of interest to students of heredity is the set of chromosomes. Chromosomes are rod-shaped or thread-like bodies, definite in number for a species and occurring in pairs. (These facts are formally pictured in the accompanying diagram.) Historically considered, however, the first cell or reproducing particle is unique, for it results from the fusion of two other cells which are known as gametes. One of the gametes, the egg, is contributed by the female, the other, by the male. Gametes carry only half as many chromosomes as other cells of the species, and it is their fusion in the act of fertilization that establishes the paired-up condition of the chromosomes just spoken of. (See diagram, figures 1 and 2.) The paired condition is remarkably maintained following fertilization in the cell multiplication that builds up the organism. Only at its maturity do cells appear again carrying the reduced (half) number of chromosomes. (Diagram, figure 4.)

It has long been known, among beekeepers at least, that the male bee or drone results from an unfertilized egg. In other words, the whole body of a drone is built of cells holding only the half number of chromosomes as is characteristic of gametes. A fact like this indicates that one set of chromosomes may contain all that is needful in order that an adult body be formed. In general, however, the cells of a plant or animal body possess the double number of chromosomes whether they all be necessary or not.

At this point it may be asked why a reader interested in heredity should be burdened with facts concerning chromosomes. The reason is this: a great body of genetical facts accumulated during the last two decades indicates that hereditary traits are conditioned by very small particles called genes or factors, and that these genes or factors *are carried by the chromosomes* in some sort of serial order. As the chromosomes go, so go the contained genes, and one must be acquainted with the maneuvers of chromosomes in order to possess a philosophic conception of heredity.

Since the chromosomes are in duplicate, the factors they carry are in similar condition, one of each pair of factors being contributed by the male parent, the other by the female. When we are dealing with pure-bred organisms the factors derived from the father are similar to those from the mother, and this prohibits us from, say, determining the relative importance of the paternal contribution and from tracing it through the children, grandchildren and subsequent generations. This is the reason why resort is had to hybridization, for when the parents differ in one or more respects it is a simple matter to follow through in the progeny what each has presented at fertilization. To make this matter concrete let us consider certain forms of the common annual Phlox. Most varieties possess

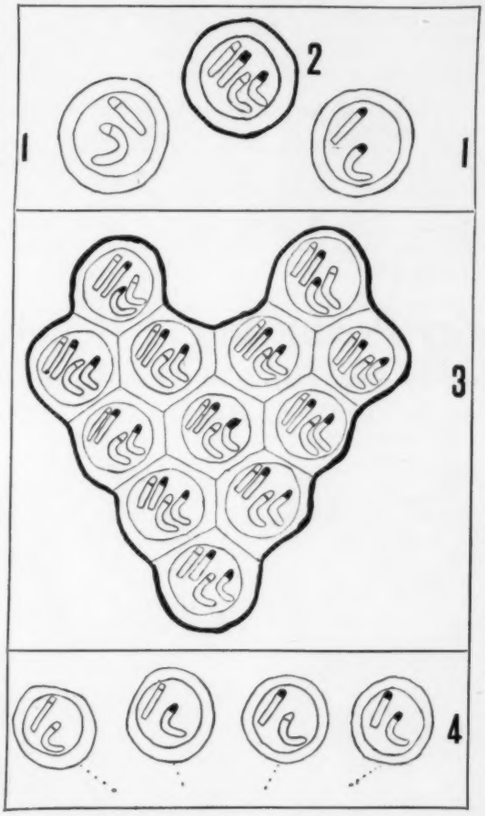
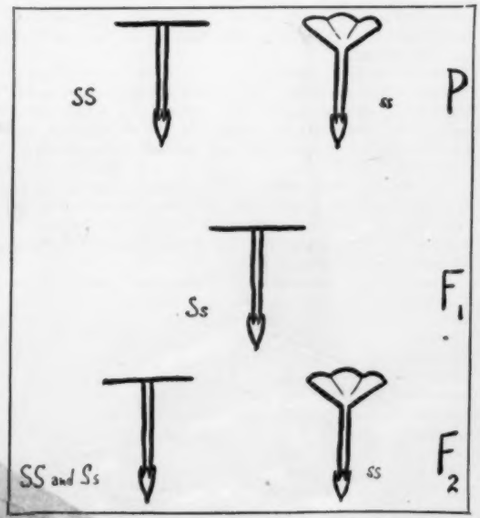


Fig. 1: The two gametic cells, one male and one female, two chromosomes being represented in each. Fig. 2: With fertilization the two gametes unite to form a single cell, the fertilized egg. Fig. 3: The fertilized egg divides, as do its progeny again and again, until there comes into being a large group of cells, the body of the adult organism. In all these cells the chromosomes remain in duplicate. Fig. 4: In the sexual glands or in the spores, cells arise containing again but half the number of chromosomes. (Adapted from Genung)

The physical mechanism of reproduction and heredity



Upper line shows diagrammatically salver-shaped flower on left, funnel-shaped on right. When crossed, they produce salver-shaped offspring, as in the second line. In the third row we have the assorted second generation that springs from parents of the F1 type

A typical chain of plant heredity

flowers which are salver-shaped; that is, each flower has the outer blade at right angles to the tube which supports the blade. (Lower diagrams.) A few strains are characterized by flowers which in full bloom are funnel-shaped. Suppose these two kinds are crossed, which can be done by taking the pollen of the funnel variety and depositing it on the stigmas of the salver. The children from such a mating—the first hybrid or F_1 generation—always look just like the salver-flowered parent, and there is no visible evidence of the funnel condition. The salver shape is labeled a dominant, the other, as a recessive, trait. Continuing such an experiment two of the F_1 salver-flowered plants are mated and give rise to a group of grandchildren called the second hybrid or F_2 generation. This group is not uniform, but is made up of 75 per cent salver-flowered *and 25 per cent funnel-flowered* individuals. The recessive trait reappears with all its original distinctness. These facts are summed up in the diagram. The F_2 ratio has received a perfect interpretation on the basis of chromosome behavior. We may picture in the cells of the original salver parent one pair of chromosomes carrying a pair of factors determining the salver shape. Let us represent the condition by *SS*, where *S* stands for the gene conditioning the salver-shape. Its reproductive cells, of course, contain but a single *S* each. In the corresponding chromosomes of the funnel strain a different pair of factors, *ss*, are assumed, which, when present in double dose, make for the funnel shape. The gametes of the latter strain hold, each, only a single *s*. The crossing gives all the cells of the children (F_1) the composition *Ss* and the gene *S* alone determines the form of the flower. These children will have, of course, gametes with the reduced number of chromosomes, and hence of factors. One-half of the F_1 gametes will carry *S* and the other half *s*. In originating the F_2 generation—the grandchildren—by the mating of two F_1 individuals we really mix together for fertilization a lot of eggs, half carrying *S* and half *s*, with a lot of male gametes, likewise half with *S* and half with *s*. Unions based merely on chance will give *SS*, *Ss*, *sS*, *ss* with equal frequency. Only the *ss* combination will lead to a funnel-flowered plant, and, as is evident, this will occur on the average only once in every four fertilizations. It is to be emphasized, by the way, that the figures "one in four," etc., given in this and other articles on heredity, are strictly averages, and are not to be interpreted as meaning that, if four offspring are produced, one will inevitably be of the character specified.

A number of comments may be made on the preceding simple case in the phloxes. The funnel characteristic is one that shows in the parents, becomes latent in the children thus skipping this generation, and reappears among the grandchildren. Those grandchildren exhibiting it would be atavistic. The atavistic or recessive character is constant from the time of its reappearance and does not need to be "fixed" by further generations of inbreeding. The potency of the factor for the funnel-shape has not been altered by hybrid association with a different sort of mate. In fact, there seems to be no known sort of influence that may be employed to change the nature of a factor. Henry Fairfield Osborn has recently stated that factors are the most stable things that he knows of in the realm of biology. The chief of the Mendelian principles is this one concerning the association without contamination or change of pairs of factors in the body cells and of their pure segregation from each other when gametes are formed. The three to one ratio among the grandchildren is dependent upon this hypothesis. It is also evident that there are two distinct types of the dominant characteristic, i.e., the pure-breeding and the hybrid, distinguishable by the progeny they give. The hybrid dominant carries along the recessive trait and gives no evidence of it on mere inspection. Feeble-mindedness in man, one kind at least, is a recessive characteristic, and this accounts for a feeble-minded child occasionally arising from two normal parents. The blue-eyed condition is similar and may appear among the progeny of brown-eyed parents.

Thus far our discussion of hybridization has dealt with cases in which the parent plants or animals differed in one pair of characters only. We advance a step in complexity when we consider what follows when forms are mated which are distinguishable in respect to two pairs of traits. To revert to the Phloxes, let us suppose that a strain having flowers salver-shaped and colored is crossed to one whose flowers are

funnel-shaped and white. The immediate progeny from such a mating is uniform and exhibits the dominant traits, color and the salver shape. The generation of the grandchildren, derived as in the simple Phlox case, is a mixture. In every 16 individuals there are *on the average*

9 colored and salver-shaped,
3 colored and funnel-shaped,
3 white and salver-shaped, and
1 white and funnel-shaped.

As an aid in visualizing the processes that underly this ratio, let us refer again to the diagram. Each of the chromosomes in the male gamete has a black mark in it. Suppose the dot in the straight chromosome is the gene determining salver shape and the dot in the curved chromosome is the gene for colored flowers. The homologous chromosomes in the female gamete are shown without marks in the corresponding places or 'loci." This signifies that they are carrying the recessive genes conditioning funnel shape and non-colored flowers, respectively. (See Figue 1 in the diagram.) Fertilization gives a cell (Figure 2 of diagram) hybrid in respect to two pairs of characters. The adult built up (Figure 3 of diagram) forms colored salver-shaped flowers and does not betray the latent genes for white and funnel shape carried in its constitution. With the formation of gametes by the adult (Figure 4, diagram) the usual reduction in chromosomes occurs. It is important to note that while rod chromosome always separates from rod chromosome (the two entering different gametes) and likewise curved chromosome separates from curved, it seems to be a matter of indifference whether the black-dotted rod passes into a gamete with the black-dotted or the non-dotted curved chromosome.

The same holds good for the non-dotted rod. Accordingly four kinds of gametes are possible (Figure 4 of diagram), and the first hybrid generation forms these in equal numbers. Now suppose a lot of eggs of these four sorts are mixed with a lot of male gametes of the same sorts and the unions are left to chance. The laws of probability will lead us to the four combinations already mentioned as found among the grandchildren and in the stated proportions.

The second of the chief Mendelian principles is exemplified in this more complex Phlox example, *i.e.*, the principle of the independent reassortment of traits or of the genes that condition them. If the colored salver-flowered strain and the white funnel-flowered strain were the only kinds of Phlox in existence, then our crossing would have enabled us to secure two entirely new creations, namely, colored funnel-shaped flowers and white salver-shaped. All organisms may be viewed as a collection of traits (dependent on a collection of genes in the chromosomes) dissociable at time of gamete formation and capable of being put together into new combinations at times of fertilization. It is this principle which caused the botanist Baur to boast that with a little time he could make Snapdragons to order.

A large part of the success of Luther Burbank is dependent on securing new combinations of characters resulting from hybridizations. There are limitations or refinements to the principle of reassortment, but all these are nicely interpretable in terms of chromosome behavior.

Quantity Production of Relief Maps

A New Process Whereby These May Be Had Quickly and in Large Numbers

By Dr. Alfred Gradenwitz

INASMUCH as ordinary maps fail to convey any adequate idea of the ground they are intended to show, endeavors have long been made to provide plastic maps, representing all three dimensions, the heights as well as the lengths and widths. Those so far produced, however, were anything but satisfactory. If made of plaster of Paris, they would, in fact, be too schematical, of dimensions hardly ever true to scale and colors only seldom agreeing with natural conditions. Though these reliefs could be manifolded, two copies of the same original hardly ever agreed with one another, while each had to be separately painted and written on. Other plastic maps were made up of a superposition of pasteboard (or wooden) sheets arranged in stair fashion: unless the stairs were smoothed over with some plastic material, these would produce a wrong impression. Moreover, all these maps were much too expensive to lend themselves to any more general use.

A flat original (left) and the relief map into which it is transformed by the new process

A Munich sculptor, Karl Wenschow, has designed a radically new process for providing relief maps of surprising perfection and remarkable cheapness; in fact, any ordinary level map can by this process be converted into an excellent plastic map.

The map to be operated on is fixed in a frame providing the proper tension, after which it is placed above some plastic material and, by moistening with some special liquid, made ductile at any places corresponding to elevations or depressions of the ground. The map having then been pressed against the plastic mass, the heights and depths are worked out with special instruments in accordance with the altitude data of the map. The ductility of the map varies from one point to the other, any tearing or other damage being effectively prevented. Ingeniously constructed apparatus allow the variable height of relief to be checked, ascertaining even the slightest inaccuracies. In fact, the level map is thus converted into a faithful model of the ground, true to scale with regard to all its dimensions and angles.

The plastic mass above referred to enables even the most minute details, such as stone bridges, railroad lines, cuttings, to be worked out.

From this primitive mold, there is produced a counter-mold, destined to be used as matrix in stamping any desired number of replicas. Special stamping machines, working under high pressure, are used in this connection.

For each plastic map to be stamped with this matrix, a level map is made ductile in the same manner as in connection with the primitive mold and is by the matrix pressed against an immediately hardening plastic mass. Stampings follow upon one another so rapidly that every five minutes a relief map is ready to leave the machine. The latter is so designed that, while one mold is in the press, another can be prepared, in order on withdrawing the former, to be inserted without delay.

Thanks to the stamping process, each relief leaving the machine is a perfect replica of the primitive mold, the surface of each being a pressed-on, previously level map. It is immediately ready for use and, as an improved map, it is suitable for a multitude of applications.

The inscriptions, colors and original proportions of the map are in no way altered by the treatment. The relief map is hard as wood and of unlimited durability, neither its dimensions nor its volume undergoing any change in the course of time.

The process above described and the possibility of manifolding open up an enormous field of application, the extent of which cannot yet be adequately gaged.

Schools—elementary schools in the first place, but even secondary and high schools, universities and technical colleges—will derive much advantage from the new type of map. While the ordinary flat map frequently conveys no adequate idea of the conformation of the soil, plastic maps give a most vivid and impressive idea of everything pertaining to geography and lend a new and unexpected interest to a doctrine generally appealing to few pupils. Inasmuch as the plastic map is a perfect replica of the ground on a reduced scale, it is the most efficient means of studying it, even before proceeding to an inspection of local surroundings, enabling pupils to check and complete the knowledge derived from the plastic map.

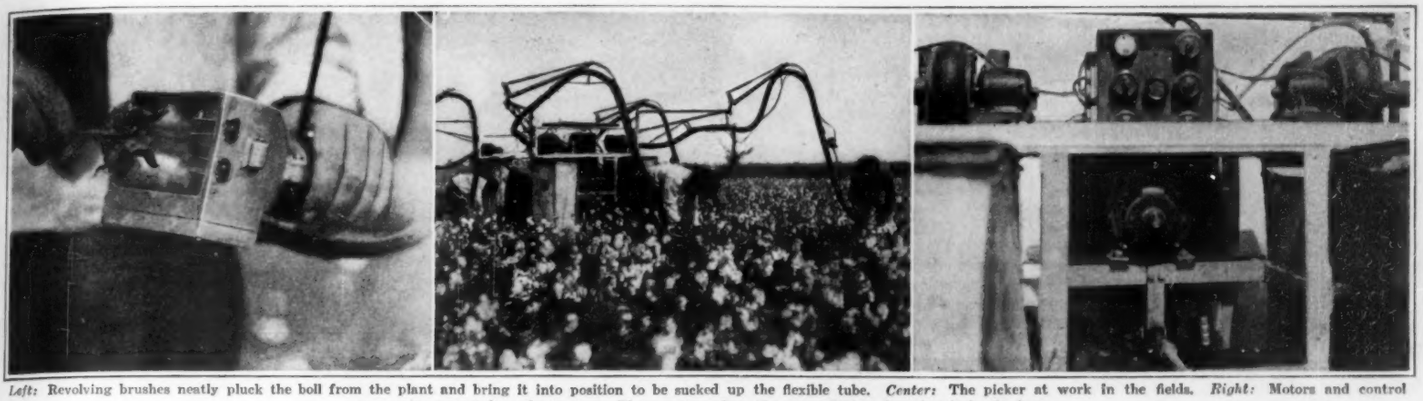
Water, mining and harbor engineers will work much more quickly when planning and demonstrating their schemes with the aid of accurate reliefs. In fact, no better means of advertising a given scheme, or schemes of a given kind, can be imagined. While engineering diagrams with their calculations, ground-plans and elevations, profiles and financial estimates will always form the basis of any project, plastical maps are bound even to interest the man in the street in things so far reserved to a narrow circle of experts. Unfortunately, as is the case of most inventions, even military circles are likely to be interested in the process above described.

In the opening up of new countries, the new process will lend invaluable help, the more so as a combination of aerial surveying with the wholesale production of plastic maps has been attempted. In fact, the company exploiting the process has associated itself with the Aerial Picture, Ltd., the Zeiss Works and the International Stereographic Central Station, with a view to combining their endeavors in the interests of culture and scientific investigation.

Whereas many decades would be necessary to survey (at an enormous cost) by terrestrial methods such countries as, *e.g.*, the interior of Africa, South America and Asia, the combination of aerial photography, photogrammetry and plastical map production will enable the greater part of the surface of our earth, which had so far been unknown, to be made accessible to mankind for the benefit of science and the progress of human civilization, thus utilizing values which it might otherwise have taken centuries to open up. Even before the colonist's foot shall have trodden the soil to be cultivated by him, he will be supplied with an accurate picture in relief of the area that is to be the scene of his future field of activity.

Gas-Burner Design

TECHNOLOGIC Paper of the Bureau of Standards, No. 193, entitled, "Design of Atmospheric Gas Burners," describes the apparatus and methods used for the investigation of burner operation. Several types of gas orifices were investigated and the coefficients of discharge determined. The principles governing air injection are discussed, and examples and curves are shown to illustrate the effect of a change in the gas pressure, specific gravity and volume of gas. The design of injecting tubes that produced the greatest injection of air was determined. Characteristics of a satisfactory burner are described. The relation between total port area of burners and the capacity of burners is fully discussed.



Left: Revolving brushes neatly pluck the boll from the plant and bring it into position to be sucked up the flexible tube. *Center:* The picker at work in the fields. *Right:* Motors and control apparatus mounted on the tractor. These motors clean the cotton before dropping it in the bags

The electric cotton picker, and some of its details

The Successful Cotton Picker

THE cotton industry, in which human labor has played the important rôle for the 4000 or more years that cotton has been picked by hand, promises to become revolutionized by the advent of an electrically operated picker, which has recently been perfected and placed in practical operation on a plantation at Little Rock, Arkansas, in the heart of the northern cotton belt.

This new electric device makes it possible for a person to gather from 400 to 700 pounds of cotton a day, as compared with 70 to 150 by hand. And by so doing it promises to solve the greatest problem of the cotton grower, that of being able to harvest all the cotton he plants and to do so during the limited period in the fall before the rains and frosts damage the plants and greatly lessen the value of the crop.

It seems odd, yet is a fact, that any cotton grower can raise about three times as much cotton as his hired help can pick. Unlike the harvest of corn, wheat and other crops, where a machine cuts down the stalks and makes but one trip over the field for a harvest, there are three distinct crops to the cotton plant. This means a harvest period of two months or more and thus eliminates the floating labor element and makes each plantation owner entirely dependent upon his own help to pick cotton. Outsiders cannot be interested because of the slow and tedious nature of the work, which brings such small returns and has always been the task of the negro.

This is but one feature of this twentieth century picker. Other points in its favor are not to be overlooked. Thus, it will result in cotton being picked when ripe, thus improving the grade two or three times and adding $10 or more to the value of a bale. By hand, but half the cotton of the South is being picked on time before it has deteriorated in value because of weather elements.

This latest attempt to replace hand picking may be called the life work of L. C. Stuckenborg, of Memphis, Tenn. He admits that he received his real inspiration leading up to the perfection of the present machine, when watching a cow which had broken down the gates and wandered into his cotton fields. Cows will eat cotton for the seeds embedded in the fiber; and as this cow went from plant to plant, he noted the ease with which the cotton was removed from the bolls by the animal's rough tongue.

After experiments extending over 14 years he perfected two revolving brushes encased in a metal frame about the size of a man's double fist. The brushes were made to revolve inwardly, thus creating a comb-like movement, and when these were placed against the cotton, pulled it free from the bolls without collecting any part of the boll or leaves of the plant. Then, having solved the plan for removing the cotton, he adopted the much-tried suction idea for carrying the cotton to the receptacle to receive it. A flexible tube connecting with a bag on the machine did the trick.

Each machine carries a complete electric power plant. The tractor engine furnishes sufficient electric power to operate the eight motors required to run the machine. The brushes in the leads are driven by a flexible drive-shaft about three feet long, which is connected to a small motor suspended about half way down the suction tube. After the cotton completes its trip through the tube and just before it drops into the bag, it is given a cleaning by fanning, another motor operating the blower as well as providing suction power.

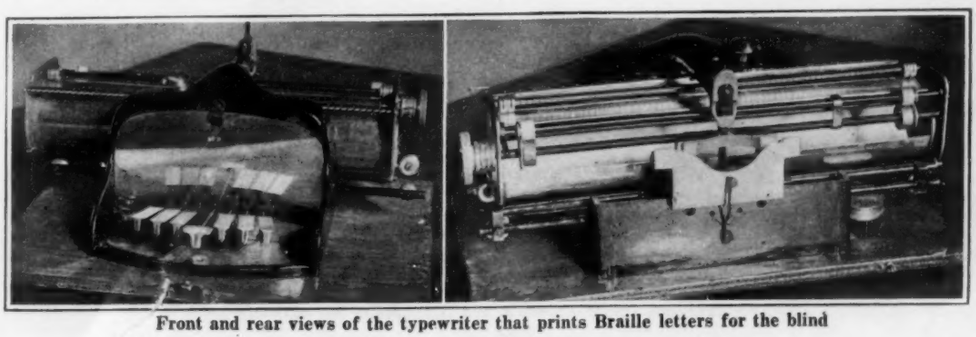
There are four picking tubes to a machine, each with its pair of motors. Supported overhead by a balance arrangement, the pickers are suspended with such lightness and flexibility that even a child could shift them about with ease. The machine as it passes through the field can pick eight rows. The negro—and several have been tried on the machine—finds no trouble in using it; and in checking up his work it has been found that where he formerly picked 100 pounds by hand he has, with only a few days' training, been picking 400 pounds by machine.

Close-up view of the Stuckenborg cotton picker and the tractor that carries it

The Braille Typewriter for the Blind

THE Braille alphabet for the blind is essentially no different, in its major features, from any other alphabet. A character for each sound—that is the ideal toward which any alphabet more or less closely approximates. But mechanically speaking, the Braille alphabet is very different from any other. There is no particular connection between the individual letters of our ordinary type or script. The Braille letters, on the other hand, are consciously and deliberately built up from six simple elements. These elements, instead of differing in shape, consist every one of them of a single dot, identical except for the single characteristic of position. If we take the six-spot on a domino, or one of the six-spots in a deck of cards, we have the whole thing there before us. And since each dot affords us the alternative of its presence or absence, we can make, of the whole six, exactly 2x2x2x2x2x2, or 64 different combinations of dots, each combination containing perhaps six dots, perhaps five, or four, three, two, one—or in one case, none at all. Excluding so far as possible combinations which might be ambiguous to the reading finger, there are plainly enough combinations to represent all the letters and to give a surplus for use as arbitrary symbols.

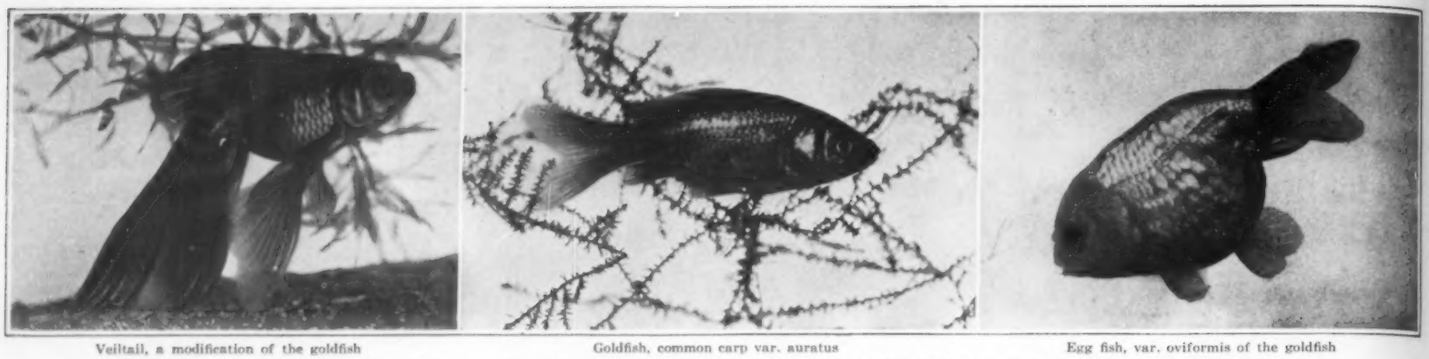
But the fact that the alphabet is so definitely composed of a small number of elements influences the design of all typewriters for the blind, one of which, of French manufacture, we illustrate. With a separate key for each letter there is a certain operating simplicity. But with a key for each of the component elements of the letters the constructional simplicity is so great, and the machine so compact, that the objection against the necessity of striking three or four keys to complete the representation of a single letter is of no weight. Therefore we have the Braille typewriter with six printing keys, one for each of the six positions in which it can be desired to strike a dot; and, in the middle of the group, a space key which shifts the paper when it is time to pass on to the formation of the next letter. With the further remark that the machine is really an embossing rather than a printing one, that is all there is to it.



Front and rear views of the typewriter that prints Braille letters for the blind

Low-Pressure Safety Valve

SAFETY valves designed for low pressure are important for certain uses. It is desirable that such valves open at a predetermined pressure and seat tightly so as to minimize leakage. A new form of safety valve to fulfill these requirements has been designed and constructed by the Bureau of Standards.



Veiltail, a modification of the goldfish | Goldfish, common carp var. auratus | Egg fish, var. oviformis of the goldfish

Three variations of the common carp, Carassius vulgaris, all of them being goldfish of plain or fancy type

From Common Carp to Fanciest of Gold Fish

Some of the Wide Variations Which Are Comprised Within a Single Scientific Classification

By Ralph Howard

ANIMALS which man has domesticated and which have multiplied under his supervision often differ considerably, not only in their form but also in their characteristics, from their wild relatives; so that it is often difficult to determine with any degree of accuracy the origin of the animal in question. The goldfish is a descendant of the crucian carp (*Carassius vulgaris*) which is found in the slow-running and standing waters of Europe and West Asia. In its typical form, this fresh water fish has a prominently curved back, and as such it inhabits the larger lakes. In its other form it is more elongated and slender; this is the so-called "hunger" form, and as such it inhabits the smaller ponds. From the latter form the goldfish has been developed.

The carps, and especially the crucian forms, possess the characteristic of taking on a more or less intensive glaze, the fish being then colored red or yellow. This means that inceptive albinoism is a trait; true albinoism, a white coloration, being seldom observed in aquatic animals. A yellow coloration is scientifically known as xanthochroia; here the dark cells are filled with a more or less intensive yellow pigment.

The yellow color, noticed by the Chinese, was the starting point of a golden-yellow crucian carp. Then, through observation and selection of those fish which happened to possess a different color and those which had the desired shape in the highest degree, the goldfish was slowly developed. But this again was the starting point of still other races which often had the most bizarre shape, and artistic form, and these are the ornamental fish which are so universally liked.

Of those forms which have been developed from the goldfish the most common are the veiltail, telescope, telescope-veiltail, egg fish, lion head, celestial, and comet. The comet has a simple caudal fin which is broad and long; in all other forms or races this, as well as the anal fin, is doubled, the rest of the fins being abnormally large. The doubling of the fin is explained by the fact that, in the embryo stage, the fins are in two symmetrical halves which, under normal conditions, grow together. If this does not happen, the fins of the fish remain doubled. At the same time the skeleton is extraordinarily changed in its structure, the bones being paired. No other free living fish is so characterized. Veiltails have also been developed which have had three tail fins, the center one being normal, while the two others were placed on each side.

The full beauty of the veiltail is developed in the second year. Perfect specimens must have an entirely divided tail fin and it should be a delicate long veil-like structure hanging downward. The anal fin must also be doubled. The dorsal fin should be high and long, and the other fins should also be peculiarly placed. The telescope veiltail must have, in addition to these peculiarities, well-developed eyes placed on a tiny eminence so that they protrude from the head, giving them the appearance of small telescopes. It is interesting to observe that these fish can be perfectly black, a characteristic which has been but seldom observed and is known as melanism.

Lion heads, egg fish, and celestials do not possess dorsal fins. Their other fins are not particularly enlarged, but their anal and caudal fins must be doubled. The older lion heads are characterized by fleshy protuberances over the head. The lion head and egg fish differ from the celestial in that the latter has eyes resembling those of the telescope, but with their pupils placed in such a position that they can see only upward.

Of all these various races of goldfish, species have been developed which not only have their normal scales, but which, as the fanciers say, are scaleless. But this is not an absolute fact, since the scales of the latter are in such a condition that they are scarcely visible, and being without pigment they are often as clear as glass.

All goldfish races are deformed. In fact this is more than a mere deformity for the swollen belly, the protruding eyes of the telescope and the celestial, the doubling of the fins, the lack of dorsal fins in the celestial, and the lion heads, are produced through a disease which is transmitted from generation to generation, and is called yolk weakness. The embryo of these races have the sickly property of absorbing water into the food storing yolk.

The breeding of these goldfish types is not at all difficult in the balanced aquarium. As a rule two males are placed together with one female. The sexes differ at their anal part, the female having a short, slightly protruding egg tube, while the male has a slight notch at this particular spot. As soon as it becomes warm the breeding season sets in. The males begin to drive the female, the loveplay lasting some time. Finally the female lays her eggs in the delicately feathered water plants. When the spawn has been deposited the parents should be removed from the aquarium.

The young hatch in from three to eleven days, and they should be placed in an older aquarium where the glass has become coated with algæ. Here a sufficient supply of infusorial food will be found by the fry. After 14 days the young fish are too old for this tiny food, they then require larger crustaceans such as *daphnia* and *cyclops* which inhabit all of our ponds and lakes. This is the natural food for them and they will thrive amazingly on it.

Older species should not be fed with live food, as this may cause an accidental introduction of parasitic diseases. It is better to provide them with raw, scraped, lean meat, small earthworms, and a better grade of the artificial fish foods found on the market.

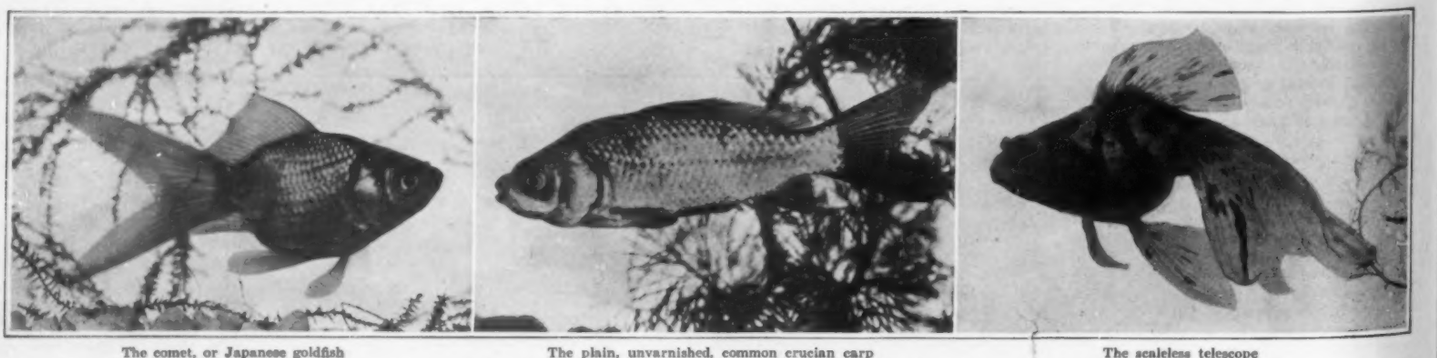
For the successful development of these fish no elaborate aquarium is necessary. They are satisfied with a simple tank provided with growing water plants.

The eye must first become accustomed to the peculiar racial characteristics of those highly developed and specialized animals which man has formed before they can be appreciated. But under no circumstances can it be denied that these products of selective breeding are unique and grotesquely beautiful. And in addition to this the care of such animals, and their breeding in the naturally balanced aquarium is full of fascination.

Paris Technical Conference on Radio Regulation

DURING the past summer the principal nations have been represented at a conference having for its object the formulation of regulations governing the use of radio by different nations.

Two delegates from the Department of Commerce were present at the conference, and various important rules were laid down. These include, recommendations as to the frequency of waves which shall be used for various distances, the use of similar frequencies by stations in the same locality, the employment of the least possible number of wave lengths by each nation, and the recommendation for the utilization of the directional properties of radio. These recommendations, however, are not binding upon any of the nations which were parties to the conference.



The comet, or Japanese goldfish | The plain, unvarnished, common crucian carp | The scaleless telescope

Carassius vulgaris himself, and two more of his offshoots

Making Tea from Holly

By S. R. Winters

A SPECIES of holly, growing riotously over 40,000 square miles in the South Atlantic and Gulf States, may in the not remote future be converted into a beverage in quantity production. George F. Mitchell, tea specialist of the Bureau of Chemistry, United States Department of Agriculture, has correctly appraised the value of this native plant, sometimes called cassina, as a stimulating drink similar to imported teas and coffees. This shrubbery, with its brilliant red berries and evergreen leaves, grows wild over an area extending from the James River of Virginia along the coast of the Southern and Gulf States to the Rio Grande River of Texas. The plant, at present, has wide appeal for decorative purposes and as Christmas trees during the festive season.

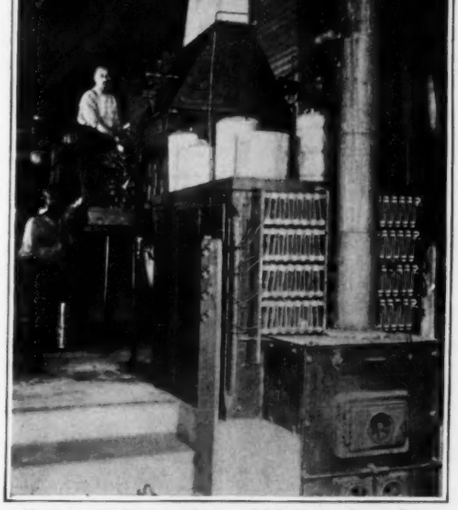
The use of this species of holly as a beverage is not a modern discovery. Its use by the Indians is most interestingly described in publications by Dr. W. E. Safford of the Department of Agriculture and also by Dr. E. M. Hale, formerly in the service of the Government; and in a crude way a drink has been made from holly in Southern homes from earliest recollections until the present day. Chemical research, however, had failed to establish the caffeine content of cassina until 1872.

The exigencies of the World War were cause for a renewal of scientific research on the subject. Responsive to a request from the National Research Council for a native source of caffeine for medicinal and chemical purposes, Dr. Frederick B. Power and Victor K. Chesnut of the Bureau of Chemistry, United States Department of Agriculture, focused their attention on the berry-producing holly. Samples of the leaves analyzed by these chemists evidenced as high as 1.65 per cent of caffeine. It remained, however, for George F. Mitchell, tea specialist of the Federal Government, because of his knowledge of cultivation and manufacture of tea, to appraise the commercial possibilities of the riotous growth as a beverage. The application of scientific methods, according to his belief, in the curing of the holly leaves and in the manufacture of the beverage seems to promise, on a commercial scale, a native drink of rival popularity to imported tea and coffee. Laboratory experiments in Washington and reinforced observations in the South during the past summer, seem to indicate that a delicious drink can be produced.

Simple ways of harvesting and manufacturing the leaves of this species of holly into a beverage are in the interest of economy of production. All of the leaves contain caffeine. The system of planting and pruning commercial tea plants in Japan could be duplicated to advantage. Hedges can be cultivated, a practice observed in the South where effective windbreaks are desired. Young plants, under cultural conditions, grow about five feet the first year. Prunings would be desirable once or twice a year, the offshoots and leaves being converted into tea. The second year the new growth could again be separated from the parent plant, the pruning being a few eyes above the old wood. This practice obtains in the culture of tea-producing plants in Japan. For ten years this procedure could be duplicated; after then the plant would involve "collar pruning," a cutting off of the shrub even with the ground so as to make way for a new and virile growth. The holly branches may be divorced from the parent shrub either by hand or machinery.

The tea as now being concocted from cassina in the laboratory of the Bureau of Chemistry is of two colors, one being dark and the other of a greenish hue. The manufacture of the former on quantity production involves the stripping of the holly leaves from the branches previously pruned and rolling the leaves in a tea-rolling machine. This procedure does not curl the leaf, as is true in the production of imported tea, but shatters the cells of the leaf, thus turning loose the juice of the plant. The leaves are fermented from three to eighteen hours, after which they are dried at a temperature of 230 degrees Fahrenheit in a conventional tea-drying machine. Subsequently the leaves are equalized in a machine resembling a coffee mill. Then the finished product is marketable. The drink is concocted in a fashion known to homes in making coffee—either boiling the shattered leaves for two minutes or percolating for five minutes. If the holly leaves are to be converted into a tea of greenish color, stripping of the leaves from the branches is unnecessary.

Type of tea-rolling machine proposed to be used in the manufacture of cassina



The tea-drying machine which it is planned to transfer to the production of cassina

Chemistry, in the process of destroying the oxidizing agent with live steam, detaches the leaves from the stems. Or, in the absence of this effectual agent, the stems can be removed in a manner similar to that of the farmer threshing cowpeas. Thus the cost of manufacturing this new drink of a greenish hue is reduced to a minimum. Beverage from cassina, on a commercial scale, may be produced by the conventional machinery known to the manufacturers of tea in Japan. The units of machinery, however, may be curtailed materially in the production of a drink from holly.

Holly, known as the "Christmas-berry tree," grows luxuriantly and riotously in Virginia, North Carolina, Georgia, Florida, Alabama, Louisiana, Mississippi, Texas and South Carolina. Other than its frequent occurrence in a wild state, there are cultivated hedges serving as windbreaks on farms and as ornamental groves. Plans of the Department of Agriculture already contemplate the propagation of this species of holly from both cuttings and seed. The latter method has not heretofore been attempted. The abundance of wild growth, scattering as it is over a wide area of fields and forests, lends itself to one essential objection, namely, it would have to be gathered by pruning with hand labor. Cultivated hedges, according to those familiar with tea culture, overcome this criticism inasmuch as the leaves and branches can be harvested by machinery. The latter feature contributes to the economy of manufacturing the beverage. Community factories, which would utilize prunings from the riotous growth as well as cultivated plants in the making of beverage, is the ultimate objective of the chemists.

Thistle Gardening in San Francisco

By G. A. Orb

IN the backyards of San Francisco and the Half Moon Bay region we find a giant thistle being cultivated for its food value—a giant thistle of Mediterranean origin with spines which are both relentless and cruel, but a large purple flower most gloriously scented which holds an irresistible lure for the bees; a giant thistle which so loves its adopted home that it refuses to be grown elsewhere in spite of the many attempts to do so.

This same thistle with its wonderful, big buds and great Corinthian leaves with their prickly spines, is known to the consumer as the artichoke; and such a delicacy do we regard the bud of this same flower that it sells for a higher price than the famous Hood River apples, Fresno raisins, Florida oranges, or Santa Clara apricots Indeed, in our cities not only do we find it displayed in the fancy grocery, but not unusual is it to find the push-cart peddler devoting a part of his limited space to the same delicacy, and both the rich man and the poor man buys it—often paying as high as a quarter apiece.

We might perhaps better speak of this unique industry as floriculture rather than as market gardening; but by whatever name we call it, California reaps the nice annual return of better than a million and a half from it. The artichoke season begins early in the days of October and reaches its crest about the first of April: nor accidental is it that it should reach its height just at the time when it will make the most definite appeal to the city consumer. St. Louis, New Orleans, New York, Chicago, as well as the cities along the Pacific slope, all draw their supply from San Francisco. From this region (and the land just a few miles south) there was shipped last year some 500 carload lots; 350 of these went to eastern cities, and 150 to cities along the Pacific slope, while, of course, San Francisco itself is a big consumer.

Twenty-five cents apiece does not seem such a high price to pay for this delicacy when we stop to think that it must go on the market in the middle of the winter when the appeal to the popular taste will be most powerful; and when we realize what a back-breaking job it is to carefully prune and cultivate the plant so that it may break forth into blossom at just the identical time we desire, and that this same blossom shall hold all of the delicious succulence which makes it so loved. The grower cuts back his plants in June, and it is marvelous how soon after the plant has been pruned to the very ground the great new leaves and sturdy flower stalks make their appearance. And if it be given plenty to eat—for it has a ravenous appetite and must have plenty of fertilizer, plenty of water, with long days of bright sunshine and a rich black loam soil—it will be most accommodating and bud and blossom just as the gardener would like. But woe betide the gardener who cuts down the ration!

An artichoke garden, showing the big buds and the great leaves with their prickly spines

Roentgen-Ray Photography

Some Recent Applications of the X-Ray, and Some Bizarre Results

By P. J. Risdon

SOME interesting research work has recently been carried out in connection with the application of X-rays. Dr. Heilbron, of Amsterdam, among others, has proved that in the world of art forgeries and alterations to pictures can be detected with ease—a much-needed protection for those whose taste lies in the direction of "old masters." Dr. W. F. D. Chambers has turned his attention to experimental work in connection with the nature of the rays, and from a scientific point of view his discoveries are of importance. Fig. 1 represents a thick lead sheet (which is impervious to the rays), out of which narrow, triangular sections have been carefully cut. There was no apparent reason why the shadows should not have been identically the same along each side of each of the triangular slots. A number of photographs resulted in the curious shadow effects shown, which prove that the rays vary according to the angle at which they leave the anti-cathode. Upon striking the object perpendicularly, rays leaving the anti-cathode at a certain angle were deflected by the object, producing the one-sided shadow effect. Rays proceeding from the anti-cathode at another angle produced an almost symmetrical effect.

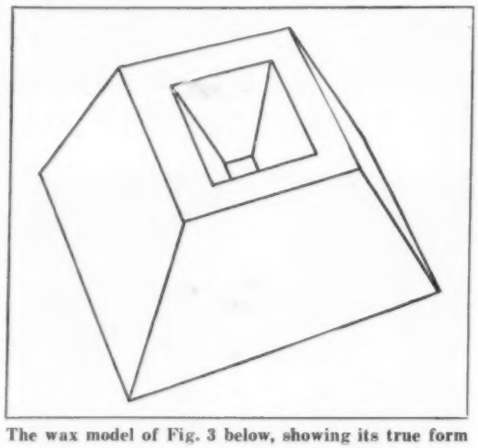
In the case of an X-radiograph of a lead disk in different positions in relation to the cathode of a Coolidge tube, the asymmetry of the rays is again made manifest. The disk was not moved, but the Coolidge tube was pivoted so that it could be turned, and the rays proceeding from the anti-cathode at different angles could be directed perpendicularly upon the disk.

Fig. 3 is an X-radiograph of a model of paraffin wax, shown in line in the center of the page. It will be seen that the edges of the convex surfaces show up as white bands and the edges of the concave surfaces as black bands. It is supposed that these effects are produced by excitation of the photographic plate by the rays (after passing through the object). Dr. Chambers claims to have proved that these "characteristic" bands are not due to lens distortion, as was previously supposed, since his experiments were made without lenses.

In illustrating an astonishing effect of rediffraction of X-rays two large lead plates were used. In the center of the one nearer the tube a pinhole was made. In the center of the other plate, which was placed a short distance away and parallel with the first, a similar hole was made, and round it 8 holes 2 mm. diameter. The direct rays of the "pencil" formed by the pinhole in the first plate passed through the central hole in the second plate, so that only diffracted rays acted upon the second plate. The surprising result was that each of the eight circular holes appeared on the photographic plate as black and white lines forming two sides of a square. Had they appeared as two parallel lines the effect might have been ascribed to polarization; as it is, no explanation has yet been offered of the result beyond the suggestion that the rays may be divisible. Only faint traces of the eight holes in the second plate were detected. We may almost expect to hear next that Dr. Chambers has squared the circle with his X-ray machine!

As another illustration of the effect of asymmetry and of diffracted rays, rays diffracted by a lead disk and falling upon another lead disk with six circular holes in it resulted in some curious photographs. In one case all six holes appeared curiously distorted. In another only four out of the six appeared at all.

The application of X-rays in the realms of commerce is far from uncommon. In the examination of materials for flaws and other defects it is unnecessary to take radiographs except when imperfections are discovered. The article is merely placed in position and visually



The wax model of Fig. 3 below, showing its true form

examined. There is practically no ordinary article of commerce now, except lead, which is impervious to the rays.

Fig. 2 is a radiograph of a weld in a steel bar showing imperfections in welding. The white patch is a cluster of air spaces. The rays are capable of penetrating half an inch of steel. Imperfections in airplane spars are similarly detected. The rays penetrate 12 inches of wood with the greatest ease. The sample spar was planed perfectly smooth and the grain is seen to be straight and even. But if there should be an internal knot, shake or crack, it would distinctly appear in the radiograph.

By way of showing how easily the rays penetrate aluminum, in a radiograph of the head of an aero engine one may see the core wires round which the metal was cast.

Of a very different character are some excellent X-radiographs of medical subjects by Dr. Robert Knox, of London, some of which were taken with an exposure of a second or two as compared with 20 minutes in the early days of X-radiography. One shows the disposition of bones in a pair of small feet. Another is of a fractured femur, during the process of healing, showing how the two halves unite and grow together again. In a third, a mottled, egg-shaped patch is a collection of stones in the gall bladder of a woman. As may be supposed, it was a serious case.

An interesting instance occurs of the application of the rays in connection with appendicitis. As a rule, in a radiograph the appendix would scarcely be perceptible; it is only when filled that it shows up dark, with a slight break between the solid contents. Again, where normally the lungs should appear almost white, in the case of a patient in an advanced stage of consumption the lung on one side is useless, while the mottled appearance of the other lung indicates a serious condition. In this view the ribs show as dark bands.

An X-ray view of special interest to horticulturists is a radiograph of a cluster of flowers. This application of the rays opens up the possibility of detecting and studying diseases of plants and flowers.

For permission to publish these pictures our acknowledgment and thanks are due to the Roentgen Society, London; Dr. Robert Knox, Dr. W. F. D. Chambers and the Cox-Cavendish Co. of London. It is to be regretted that, on grounds of space, it has been necessary for the editors to exclude some of the views put in their hands by the author, and to refer to these through textual description alone.

How to Get Better Service with Less Natural Gas in Domestic Gas Appliances

MANY of the towns and cities of this country are dependent upon natural gas and are not provided with artificial gas plants. It is estimated that if the sources of natural gas should become exhausted, it would take $1,000,000 worth of artificial gas per day to replace it. As natural gas is an extremely limited resource, the greatest interest should be shown in any means for lessening its consumption, provided good service is still rendered.

Circular No. 116 of the Bureau of Standards, issued by the Superintendent of Documents, Washington, D.C., at 5 cents per copy, describes ways in which better service can be obtained by slight modifications in existing appliances. It is shown that by proper location of a burner and by the use of open-top stoves only one-fourth of the present amount of gas will be needed to render even better service than is now obtained, lower pressures could also be employed, thus lessening leakage and its attending waste.

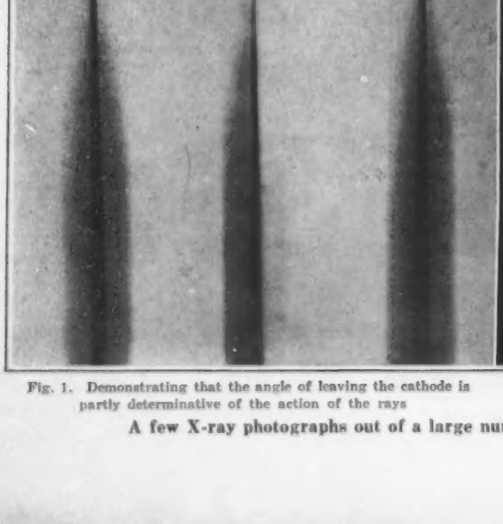


Fig. 1. Demonstrating that the angle of leaving the cathode is partly determinative of the action of the rays

Fig. 2. Radiograph of a weld in a steel bar, showing welding imperfections

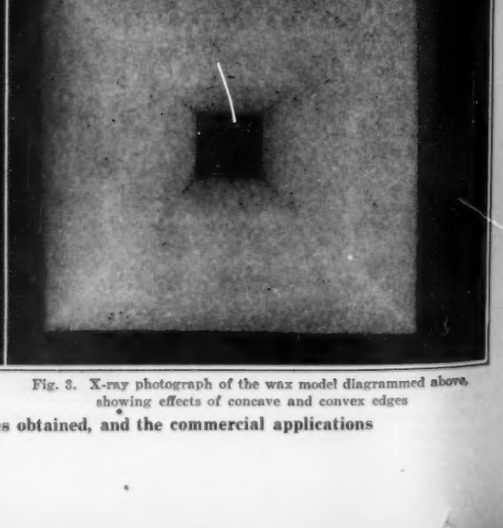


Fig. 3. X-ray photograph of the wax model diagrammed above, showing effects of concave and convex edges

A few X-ray photographs out of a large number which illustrate the peculiar effects sometimes obtained, and the commercial applications

Salvaging Fuel from Boiler-Furnace Refuse

THE development of a process for washing boiler furnace refuse deposited at certain industrial power plants so that one ton of valuable fuel may be recovered from each five tons of refuse is a scientific achievement of which Thomas Fraser and H. F. Yancey of the National Bureau of Mines well may be proud in this era of excessive freight rates and costly coal. The importance of this new process is immediately apparent when one stops to consider that over 24 per cent of our total production of bituminous coal is used in industrial power plants. The recovery of unburned fuel from furnace refuse presents interesting possibilities, and unquestionably many of these heavy fuel users will avail themselves of this technical opportunity to recruit their daily coal supplies from their mountainous heaps of refuse. When our domestic freight rates are low and under conditions where the price of coal approaches levels prevalent a decade ago, it is problematical whether it would pay to devote time and energy to fuel salvage of this description. However, with conditions as they are and the cost of recovery only 75 cents a ton, it is practical to rescue stowaway coal from power-plant scrap piles.

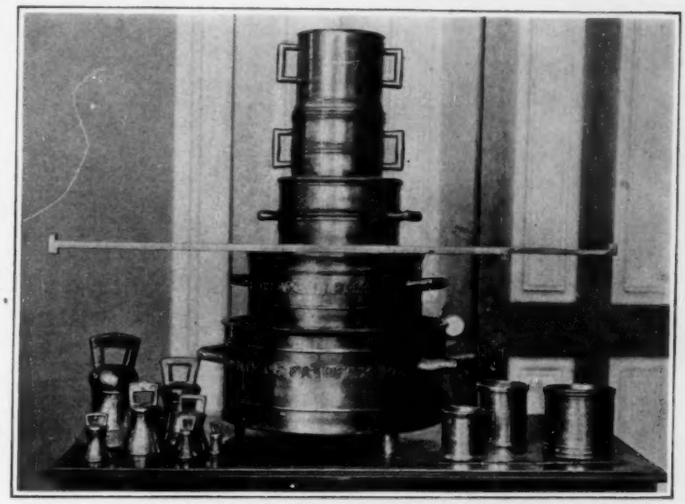
In European countries where coal normally commands higher prices than in the United States, considerable experimentation and study have been devoted to the matter of increasing fuel utilization efficiency. In Germany a process has been developed for separating unburned coal from refuse by the use of a special, electromagnetic separator. In this country the employment of mechanical stokers favors the use of low-priced screenings of high ash content, so that even under circumstances where relatively high percentages of combustible material remain in the refuse, the monetary losses are excessive only under conditions like those now prevalent when freight rates are frenzied and mining expenses unusually steep.

The amount of unburned fuel present in boiler-furnace refuse necessarily varies widely in different plants and largely will determine whether or not it will be practical to institute this salvage practice. Washing tests made in the laboratories of the mining department of the University of Illinois show the possibilities of recovering unburned fuel by crushing the refuse to pieces not larger than three-eighths inch on coal washing tables, and subsequently removing the slime from the washed product by use of special screens or by means of a dewatering conveyor elevator. The coal-washing table used in these tests had a linoleum-covered surface 8 feet wide and 18 feet long supported in a horizontal position with an adjustable traverse inclination. An eccentric head motion at one end gives the table a longitudinal, reciprocating motion of between 235 and 265 strokes per minute. The refuse is deposited at one side of the table by means of a stream of water and due to the juggling motion of the table this waste material is subjected to stratification which results in the deposition of the light material on top and the heavy refuse at the bottom.

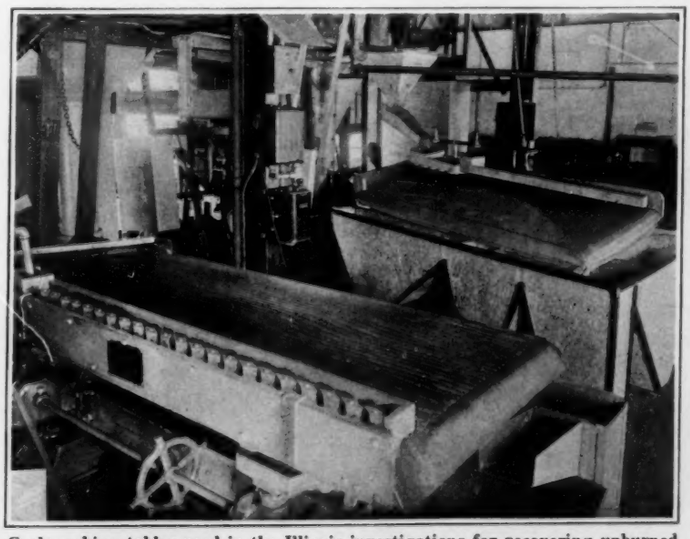
The light material, which in furnace refuse washing ordinarily consists of coal or coke, is carried over the low side of the table by the flow of water. Additional streams of water are supplied by means of a distributing launder. The heavy material, which is principally cinder, is prevented from washing down across the sides of the table by means of inclined cleats. The reciprocating motion of the table, which has a slow forward stroke and a quick jerk back toward the head motion end, works the discarded material toward the end of the table, where it drops into a deposit place separate from the cleaned fuel discharging from the side of the table.

Experimental tests have demonstrated that the total amount of washed fuel recovered was 20 per cent of the gross weight of the refuse treated. Operation of a table washery such as has been developed in these Illinois investigations results in the salvage of one ton of fuel from every five tons of refuse handled. An ordinary one-table unit is adequate for the average power plant which produces approximately 120 tons of refuse every 24 hours as this would admit of the continuous operation of the salvage table. The equipment essential in a simple power plant consists of a corrugated roll crusher to which the refuse is fed directly by a chute from the power plant. The crushed material should be stored temporarily in a feeder hopper from which it may be fed to the washing table by means of a short screw conveyor. Two conveyors are used to transport the recovered, washed fuel and the discarded material to their respective storage bins. They also operate to remove the water and fine slime from the fuel.

Dewatering of the washed fuel is essential because a considerable proportion of very fine ash washes over the table with the coke, and the removal of this slime ordinarily will result in a reduction of several per cent in the ash content of the recovered fuel. In addition to reclaiming the combustible coal lost in the refuse, this treatment cleans the cinder and makes it more suitable for use as a road material, in concrete mixtures or in other construction work. This treatment also reduces the cinder to a more uniform size, so that it can be conveyed in pipes by steam or water pressure. Operation of a one-unit recovery table of this description would require only a part of the time of one man, as a coal-washing table only requires occasional attention after it is started and properly adjusted. In most cases the freight charges on coal purchased to replace this recoverable, unburned fuel would be more than sufficient to cover the cost of operation, according to the conclusions of Messrs. Fraser and Yancey after comprehensive experiments and investigations.



Set of test weights and measures presented to Fairfax County, Virginia, by George III, and just retired from official use



Coal-washing tables used in the Illinois investigations for recovering unburned fuel from furnace refuse

Electrical Operation of Suction Dredger

A TWENTY-INCH suction dredger in use on the Sumas River in Washington was recently converted from steam to electric operation by a rather simple manipulation. As now arranged, the dredger has a total connected load of 1322.5 h.p., with motors ranging up to 1000 h.p. Current is used at both 2300 and 440 volts, a cable and reel maintaining connection with the shore as the vessel moves forward.

Power is taken from the 34,000-volts transmission line that parallels the line of operation of the dredger, leads running from it to a bank of three 500-k.v.a. transformers mounted on a scow moored to the bank of the river. This scow and the dredger are connected by a 1000-foot length of submarine cable carried by a reel mounted on a small scow lashed to the dredger. This cable is paid out automatically as the dredger moves ahead until all the cable has been reeled out. The transformer scow is then cast adrift and moved ahead, the slack in the submarine cable is coiled up on the reel, and a new connection is made between the transmission line and the transformer bank in its new position. In this way it is a simple matter to run the moving dredge from the fixed power source.

The two largest power units on the dredger are the 1000-h.p. motor that drives the main pump at the rate of 300 r.p.m., and the 150-h.p. motor that operates the cutter through a set of reduction gears. After the dredger had been in operation for a few weeks, material was being handled at the rate of approximately 600 cubic yards an hour at a cost for power of from 1 to 1¼ cents per yard. Under normal operating conditions the dredger requires from 900 to 1000 kw.

Relics from an Eighteenth-Century Bureau of Standards

IT was not until the City Council of Alexandria, Virginia, decided recently to have a new set of test weights and measures that the story of the measures then in use was revealed. It seems that King George of England was informed of the very crude way in which the colonists conducted their trading, and he decided that a more uniform system should be instituted. He therefore had made of bell metal a complete set of testing weights and measures and sent it in 1774 to the King's Council of Virginia. Each piece of the set is inscribed with the words, "Fairfax County, 1774," and originally consisted of a set of weights, a set of dry measures, and a set of liquid measures. The weights run from ½ pound to 28 pounds; the dry measures from a bushel to ½ peck, the ¼ peck having disappeared in some way; and the liquid measures from a gallon to a gill. Of the liquid measures, the ½ gallon, the ½ pint and the gill have also disappeared.

One of the interesting wet measures is one labeled "wine pottel." According to those who know, this measure was supposed to contain just the amount of liquid refreshment a gentleman of colonial days was supposed to imbibe in the course of a day. It holds about a half-gallon, and very peculiarly shows the greatest usage.

The measures are huge and cumbersome, the bushel measure alone being about as heavy as anyone would care to lift. The sides and bottom of each of the dry measures are about three-quarters of an inch thick, and the whole set probably weighs in the neighborhood of 200 pounds. The weights were never intended for actual use in commercial lines, but solely as test measures, and have been so used by the county for 180 years. By reason of the type of metal which was used in their construction they are neither dented nor chipped.

In addition to the weights and liquid and dry measures, there is also a cord-wood measure. It is a combination of a yardstick and wood measure, having 36 inches marked off by inches, with an additional elongation of ⅛-inch at either end for the wood measure.

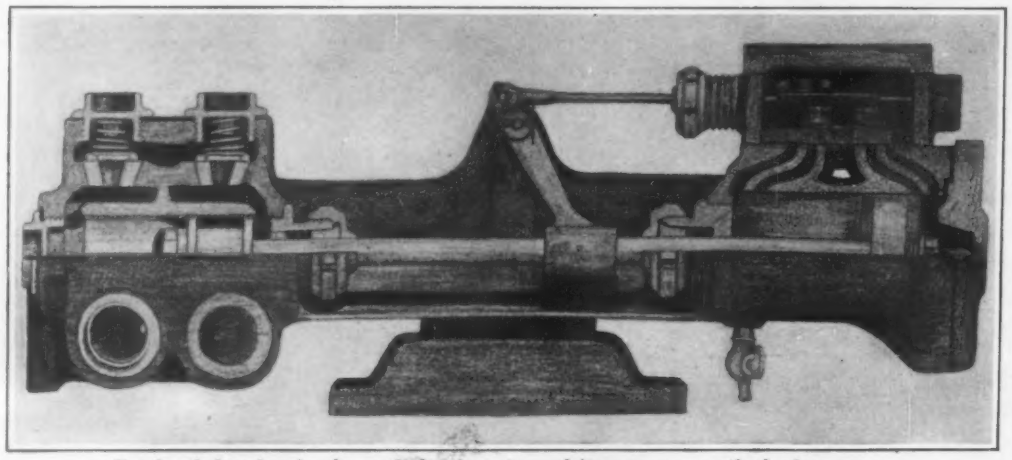
The set has been given into the care of the local chapter of the Colonial Dames whose plans call for the permanent care and exhibition of the set in the Town Hall.

Freehand Drawing in the Industrial World

How Engineers Are Being Trained to Use the Unaided Hand to Supplement Drawing Instruments

By R. E. Plimpton

FOR years engineers—and, for that matter, architects, too—have used drawings to convey instructions about natural objects. The value of these drawings is limited, however, because the customary method of representing objects, commonly known as orthographic projection, is purely conventional and can be understood only after special training. The method of execution—that is, the use of T-square, triangles and instruments—which gives the system the name of mechanical drawing in itself is a hindrance, since it can not be applied for much of the finer work.



Freehand drawing in charcoal showing steam-driven pump, partly broken away

It may seem that these limitations are too slight to be worth attention. But anyone who has attempted to puzzle out a complicated mechanical drawing, or to use instruments in drawing arcs of small circles, will appreciate the advantage of simplifying both the system and its method of execution, for the benefit of user and maker of the drawings.

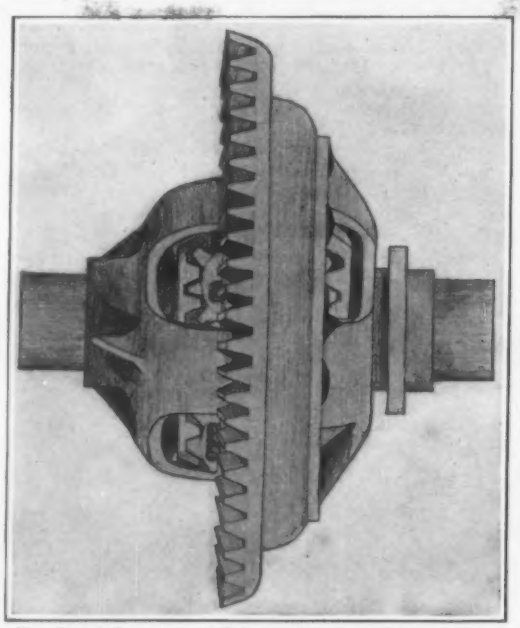
As it happens, there is an extremely simple remedy, one that can be learned and used by any ordinary person. This remedy, which is the use of free-hand drawing, is not new; yet its value is rarely if ever realized. The examples accompanying this article indicate the various uses of free-hand drawing in industry. All these drawings were made after only a few months' training in free-hand work. In fact, they were done by students in an eastern technical school, and their remarkable accuracy is due mainly to the course of instruction that has been developed in this school.

Writing is simply the drawing of arbitrary pictures, and there are conventions that can be learned and that apply just as well to the drawing of mechanical things; consequently, anyone who knows how to write can learn how to draw. This belief forms the basis of the instruction given; but its success is due equally to the method of attacking one difficulty at a time, and of retaining the interest of the students by the use of actual machinery as models.

The first task is the drawing of spheres, cones, cubes and other geometrical forms. At first these are made of wire, and later solids (wooden) are used. The student is urged to get the main proportions of height to width by the free use of wrist and arm, and so to cultivate the judgment of the eye in correctly relating model and drawing. The ability to draw effective outlines then follows, although at this early stage of the training the work in proportions is emphasized, the outlines being held secondary.

The next step is the drawing of combinations of cylinders and cubes; that is, of simple machine parts. Here the student is encouraged to feel that an object farther away looks smaller and must be drawn smaller. In this way perspective is taught, not as a complicated mathematical subject, but as a fact to be recognized in giving realism to the drawing.

As the course progresses the students take up the drawing of light and shade, or shading. Generally this is considered the most difficult part of free-hand drawing, but it proves much simpler and easier—at least for these engineering students—than the work in outline that comes later. The shading gives the objects the appearance of projection or rounding, but its main purpose is to help the student judge proportions correctly. At first the shading is crude, but it improves rapidly with practice. The students find this part of the work most fascinating, once they realize its ease of execution. The darkest shadows are put in first, to prove the accuracy of the proportions, and then the half tones, the parts of the shading intermediate between the lights and the darks. Simplicity is sought, and the student works to keep the broad masses of shade distinct, instead of trying to show the large number of minutely varying shades in any object.



Freehand drawing of differential gear, both outline and shading in pencil

The medium used by the students is fitted to their growing ability, just as are the models and the methods of drawing them. The early work is done with charcoal, because it is easy to use, covers space quickly, and can be blended with the fingers for shading. While it seems strange to the students at the start, the feeling soon wears off. A more difficult medium, the pencil, is then taken up, and its firm, clear line used to obtain the almost deadly accuracy required for outline drawings. Finally the students work with the pen, as a training in sureness of touch, or for free-hand tracing.

The training in free-hand drawing is valuable to anyone in industry, executive, engineer, salesman, who needs to put down such things as can not be described in words. The record may be a permanent one, a matter of reference, or it may serve simply as a method for quickly passing on ideas.

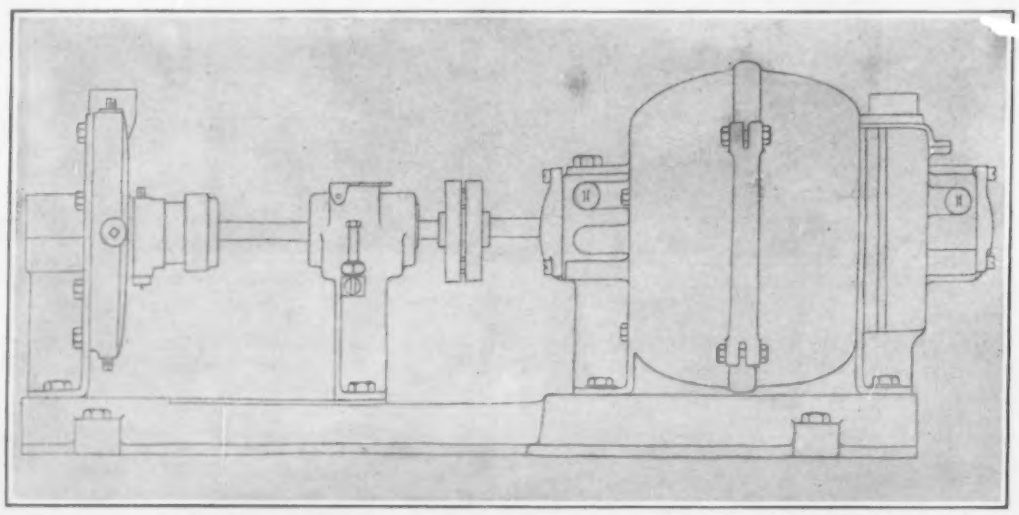
The draftsman is able to draw, without the use of instruments, the arcs of small circles and irregular curves. Or he can use his free-hand ability in drawing pictures of complicated objects, which are almost impossible to understand when orthographic projection is used. These picture drawings are especially valuable for those unaccustomed to the reading of mechanical drawings.

The use of the conventional orthographic methods, the drawing being done free-hand rather than with instruments, offers still another field. Sketches may be quickly and neatly prepared for use by the workmen who make the articles represented, or as preliminary data sheets, giving information to be incorporated later into working drawings.

The draftsman who knows free-hand drawing will be helped in his lettering, which requires good control of the hand to obtain regularity of the strokes, and training of the eye, so that the letters will appear to be spaced uniformly. The importance of this will be realized in every drafting-room, for the title, dimensions and notes of instruction are an essential part of the drawing.

In drawing free-hand the student must study closely the object he draws, and so he learns to know its construction. Here is indicated the final and perhaps the most important use of this training: to develop designers who are that in the sense the term is used in the so-called practical arts. These designers will be a combination of craftsmen and creators—men who can carry out their designs in the materials they intend to use, and who therefore can portray proportions, lines and surfaces to represent an object exactly as it is conceived in their minds. Not only this, but they are successful in making their minds, through the drawings, completely clear to their audience.

The accompanying drawings have been materially reduced and the half-tone screen is responsible for a considerable loss of fine detail found in the large originals.

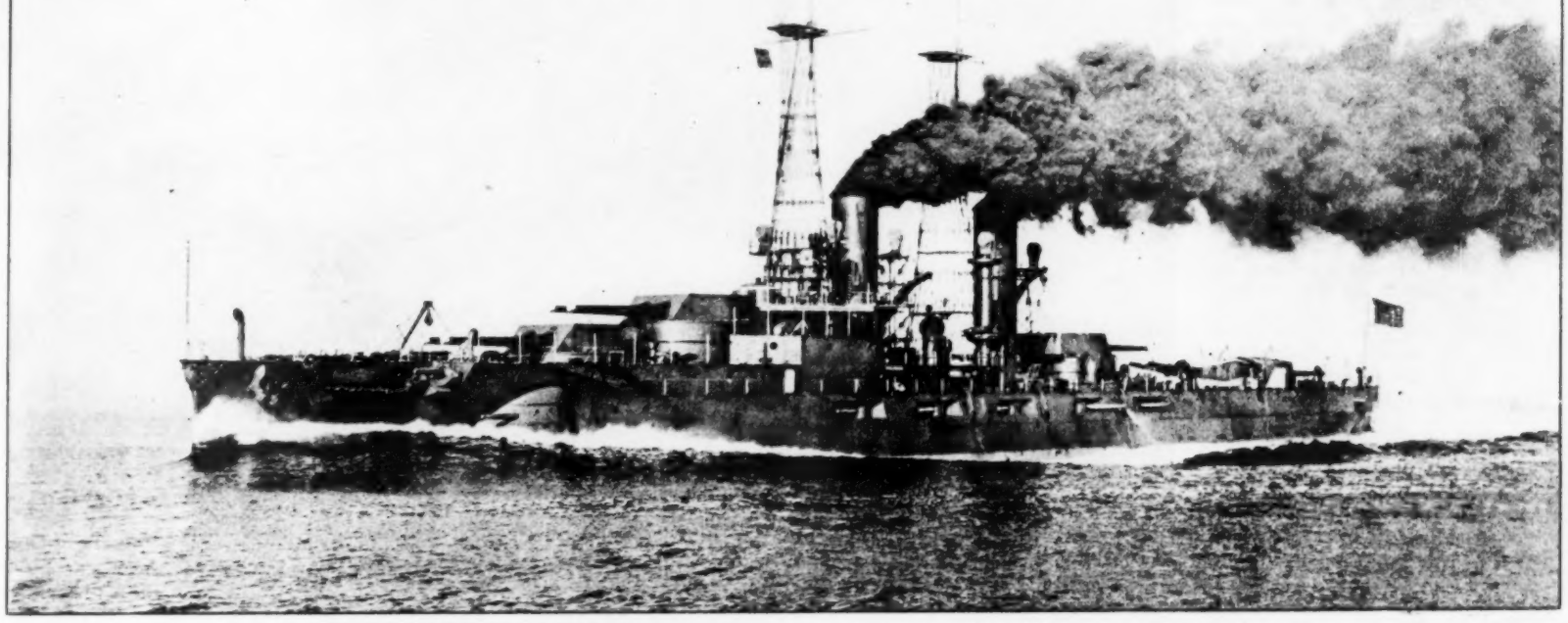


Elevation of motor-driven rotary pump, a close freehand approximation to the more usual type of mechanical drawing

Scrapping the Battleships

Torch Replaces Cold Chisel in Converting a Fleet to Junk

By J. Bernard Walker

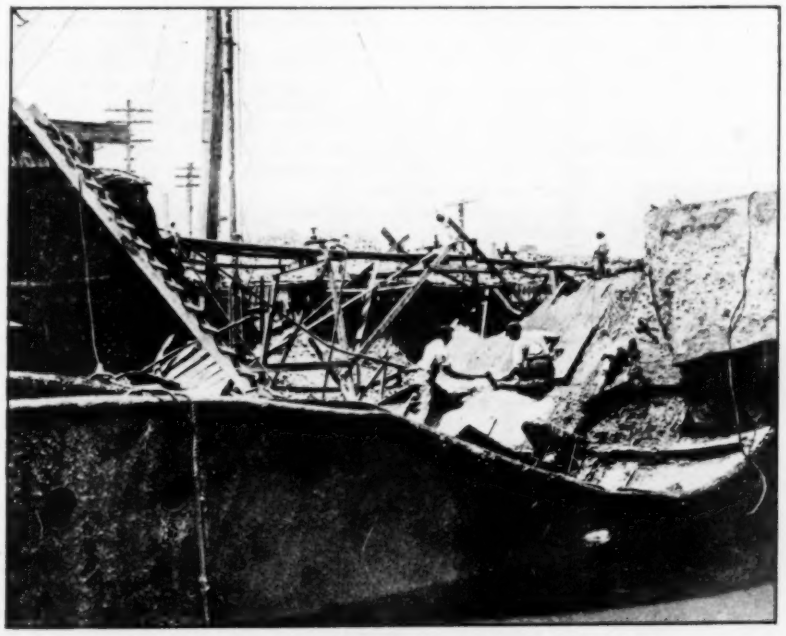


"North Dakota" and sister ship "Delaware"; two completed dreadnoughts which are to be scrapped

So far as the United States is concerned, the decision at the Disarmament Conference to break up nearly two million tons of the warships of the three principal naval powers, has brought this country face to face with a task for the execution of which it is absolutely without experience. The United States Navy is called upon to scrap over eight hundred thousand displacement tons of ships that have been built or are under construction. If we reckon into the total the completed ships, and the percentage of completion of the ships that are building, the total scrapping operation involves in capital ships, over four hundred thousand displacement tons. When this amount has been turned into marketable junk in the shape of steel and brass scrap, it will represent three hundred thousand tons of steel and about four thousand tons of brass.

Not only is this a scrapping job of enormous and altogether unprecedented dimensions, but for this nation, at least, it is complicated by the fact that there is no one among us, either inside the navy or outside, who has ever scrapped a battleship, or has any expert knowledge of how the thing should be done. The simplest method of disposal, of course, would be to tow the ships out into deep water and sink the whole fleet; but, inasmuch as the ships when broken up will represent, at market prices for scrap, a total sum of several million dollars, sinking the ships should be resorted to only in the event that the professional junk firms, and others who put in bids for the vessels, should get together and endeavor to beat down Uncle Sam to a point at which he would get practically nothing for the ships, and the ship breakers would gather in a very handsome fortune.

Ship breaking, particularly when it comes to breaking up a battleship, is an expert job. There are firms in Great Britain, Germany and Italy that have had much experience in this kind of work. Two or three British firms have several break-up yards located at different centers around the British coast. The Germans, because of the task imposed upon them by the Allies of destroying ships, guns and fortifications, have also acquired considerable data, knowledge and skill in this work. They are also breaking up ships for the British. In Italy (at Genoa, if we remember rightly) is a firm of shipbreakers which has had long experience in turning merchant vessels into junk. Although there are several American firms whose scrapping operations are on a large scale, notably the firm which formed the subject of an article in the SCIENTIFIC AMERICAN of July 9, 1921, entitled "A Giant Junk Yard," ship breaking has never figured very largely, if at all, in their operations. The late J. Pierpont Morgan once remarked that you cannot unscramble eggs, but the task of breaking up a battleship is literally one of unscrambling. Just as the huge fabric was put together laboriously, frame by frame, plate by plate, with all the major elements—protective deck, massive side, barbette, and turret armor—assembled and wrought into accurate position in the ship, so, commencing with masts, smokestacks, boat cranes and superstructure, the ship must be pulled apart piece by piece, and almost in the exact reverse order in which it was put together.



Cutting up deck of "Maine" wreck, Havana, with sledge and chisel

The old method of scrapping

At the suggestion and with the assistance of the Navy Department, we are publishing the present article for the purpose of making prospective bidders for these ships broadly familiar with the problem. Thus on page 188 we present a hold plan, an inboard profile, and a cross section of the battleship "Connecticut." These three drawings are based upon the original constructor's plans from which the ship was built. They serve to show the elaborate transverse and longitudinal bulkheading of a predreadnought battleship. Its extent may be judged from the fact that, below the protective deck alone, the hull contains over five hundred separate watertight compartments. The space above the protective deck is also freely compartmented, and all of the bulkheads shown in our sketch are of steel. The transverse section, taken at one of the 12-inch gun turrets, shows the position and thickness of the heavy armor, including the waterline belt, the upper side armor, the protective deck, the circular barbette, and the turret.

These drawings are fairly representative of the construction of the fifteen predreadnought ships that are to be broken up. Limitations of space prevent our showing any plans of the dreadnought ships of over 43,000 tons, such as the "Indiana" and the "Constitution," which are only partially completed. It is sufficient to say that they differ from the "Connecticut" chiefly in the elaboration of the sub-division below the protective deck, and in a more effective distribution of the deck armor. When the ship-breakers come to tackle these later ships, they will find that all of them consist of what are practically four or five distinct hulls, one within the other, with a space of several feet, laterally, between the shells, or longitudinal bulkheads, as they are called.

For an understanding of just what kind of material and how much is worked into a battleship, the reader is referred to the tables at the end of this article. The first of these is an analysis of the weight of materials actually built into the U.S.S. "Maine," with the non-steel material such as joiner work, armor backing and paint, listed separately. From this we find that in this vessel, as offered to the ship-

breaker, there are 9772 tons of steel and iron and about 183 tons of brass. The estimate of brass is based upon certain percentages given to the writer by the naval constructors; but although it is founded upon their intimate knowledge of the ship's structure, the total as arrived at is necessarily only approximate. The weight of steel is taken from the original estimate of weights made by the corps of specialists, who compute the weight of a ship at the time when the plans are drawn. This estimate is very close to the exact weight of the "Maine" as offered for sale.

In table No. 2 are given the principal data of the seventeen completed battleships, including the displacement, armament, armor, propelling machinery, and in the last two columns the steel and brass scrap recoverable from the ships. As the time was not available to estimate these weights for each individual vessel in the list, the ratio of steel in the "Maine" to her displacement (or 9772 tons to 12,500 tons) was applied, with modifications, to arrive at the desired figures. Thus, it is found from the official table of weights that there is actually in the "Maine" 9772 tons of steel, which is 78 per cent of the displacement. For the larger ships, such as the 15,000-ton "New Jersey," 16,000-ton "Connecticut," and 20,000-ton "Delaware," the percentage was reduced in agreement with the fact that the larger the ship in any particular type the smaller becomes the percentage of steel. Thus, the 78 per cent ratio for the "Maine" falls to 76 per cent in the "New Jersey" class, and 75 per cent in the "Connecticut." Because of the elaborate underwater subdivision and unusually heavy armor protection of the "Indiana" and "Constellation," the percentage of steel rises again and reaches about 82 per cent in these classes.

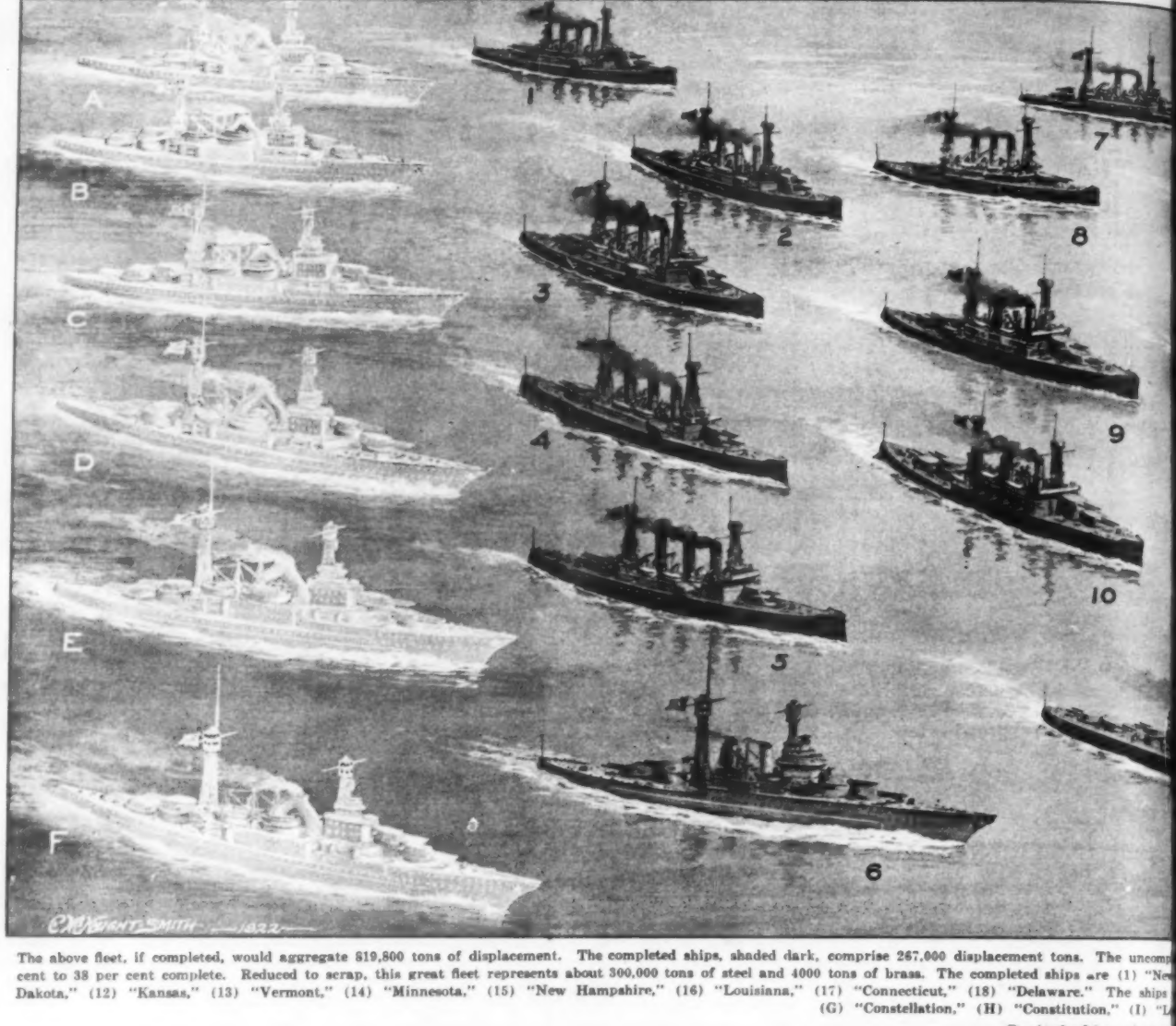
The results, as shown in the last two columns of this table, are sufficiently accurate to serve the purpose for which this article is written, namely, to act as a general guide to prospective bidders. It should be emphasized, however, that while the weights and the items are accurate as regards the ship at the time of her construction and going into commission, certain changes and additions have been made to the ship during her life, which, while they do not affect the structure as a whole, should still be borne in mind in connection with these estimates. The table is drawn up with the expectation that the bidders will personally inspect the ships and gain such additional information respecting them as may be obtained with the assistance of the staff at the various navy yards where the ships are to be found, and from personal inspection of the vessels themselves.

The weights shown in the third of our tables are obtained by first deducing the amount of steel that would have been in the ships had they been completed, and then applying to these weights as found the percentage of completion figures, given in the third column of the table.

But because of the backward condition of these ships, none of which has been launched, the heavier weights, such as armor, guns and motive power, totalling 36 per cent of the whole, have not been installed or only partially so. Hence a further reduction was necessary in the calculation. The weights as arrived at for these ships of the "Indiana" and "Constellation" class are sufficiently exact to enable an intelligent bid to be made after an inspection of the vessels at the shipyards.

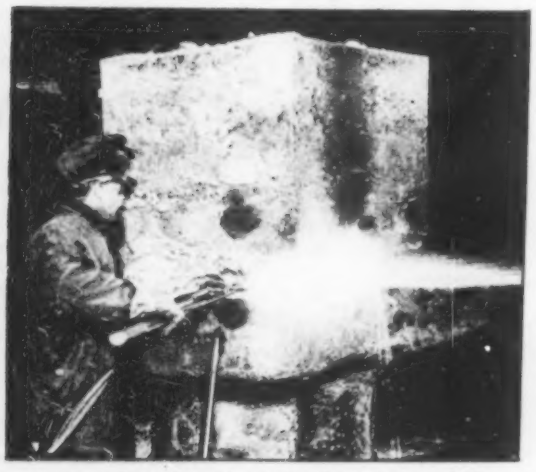
With regard to the fourth column of this table showing the amount of brass scrap in the ship, it will be noted that only in the case of the West Virginia, which is 70 per cent completed, is any figure given. This is due to the fact that in the uncompleted ships the work has not been carried to the stage at which any considerable amount of brass or copper has been installed.

The market price of scrap steel and brass fluctuates considerably, but at $12.50 per ton, the steel in the battleship "Maine" would be worth $122,150, and the brass at, say, $200.00 per ton, would be worth $36,600; a total for brass and steel of $158,750. The whole 300,000 tons of steel and 4000 tons of brass scrap in the fleet of ships would have an aggregate value, at the same prices, of $4,550,000. In estimating these values no allowance has been made for transportation, the cost of which will vary according to the distance of the break-up yard from the steel mills or brass foundries.



The above fleet, if completed, would aggregate 819,800 tons of displacement. The completed ships, shaded dark, comprise 267,000 displacement tons. The uncompleted ships are 52 per cent to 38 per cent complete. Reduced to scrap, this great fleet represents about 300,000 tons of steel and 4000 tons of brass. The completed ships are (1) "New Mexico," (2) "Mississippi," (3) "Idaho," (4) "New York," (5) "Texas," (6) "Nevada," (7) "Oklahoma," (8) "Arizona," (9) "Pennsylvania," (10) "New Dakota," (12) "Kansas," (13) "Vermont," (14) "Minnesota," (15) "New Hampshire," (16) "Louisiana," (17) "Connecticut," (18) "Delaware." The ships completed (G) "Constellation," (H) "Constitution," (I) "L... "Ranger"

Capital ships that a... erted i...



Cutting through an ingot head, 44 inches thick, with the torch

Acetylene Torch versus Cold Chisel

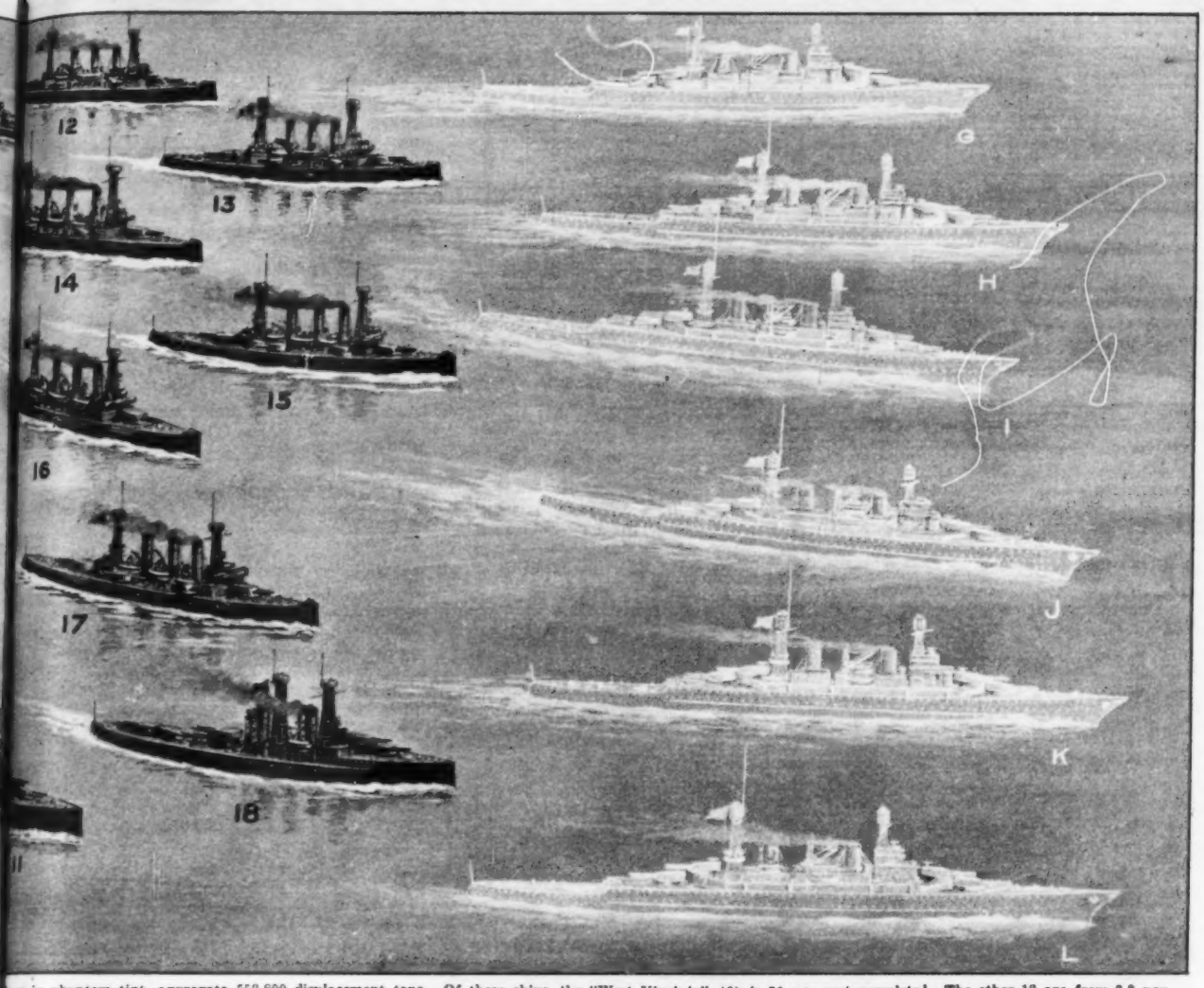
Three hundred thousand tons of steel scrap cut to suitable dimensions and delivered to the scrap pile at the steel mills, and four thousand tons of brass delivered to the brass foundry, represent, at the current prices for such materials, a very handsome sum of money. But between steel as riveted securely into the fabricated battleship and the same steel reduced to merchantable scrap there is a very wide gap, and the question of profits is very largely a question of labor. The amount of labor employed in breaking up a ship will depend upon whether the breaking up is done by hand labor or by improved mechan... of the g... methods, and above all upon the forethought and execu... of metal ... and organizing ability of the man who bosses the job. ... ch the s...

Twenty years ago, or even less, the breaking up o... battleship, or any kind of ship for that matter, wa... slow and tedious job, and the labor costs formed ... the year ... greater part of the expense. The only tools available w... been a p... the sledge and the cold chisel. Before the steel pla... nor plat... could be separated from the deck or shell of a ship, ev... suitable ... rivet had to be cut off with the chisel, and this was s... mills. ... work and costly. The historical picture of the raising ... of suc... the "Maine" in Havana Harbor, which is shown on p... by the s... 185, represents two men at work cutting up the deck p... heavie... ing of the wreck of the "Maine," after the ship had b... nothin... surrounded by a cofferdam and the water pumped ... up to the... Today, thanks to that wonderful device, the oxy-acetyl... at Heli... torch, the expense in time and labor of ship breaking h... in Gre... been greatly reduced and the job simplified. The place ... present ... the two men with sledge and chisel is taken by a sin... recently ... man using the torch. As shown in illustration, page, 1... known ac...

the operator directs the white-hot flame against the head of the rivet, quickly reducing or melting it off to the point where a single blow of the hammer drives the shank of the rivet clear.

But the burning off of rivet heads is but a small part of the varied uses to which the torch can be applied. Increase the size of the nozzle, raise the pres-

The oxy-acetylene torch was us... g up 1... Sandy Ho... ground



...wn in phantom tint, aggregate 552,800 displacement tons. Of these ships, the "West Virginia" (6) is 70 per cent completed. The other 12 are from 3.8 per ... (1) "New ... "Virginia," (3) "Georgia," (4) "Nebraska," (5) "Rhode Island," (7) "Kentucky," (8) "Maine," (9) "South Carolina," (10) "Michigan," (11) "North ... The ships ... completed are: (6) "West Virginia," (A) "Indiana," (B) "Massachusetts," (C) "Montana," (D) "North Carolina," (E) "Iowa," (F) "South Dakota," ..." (I) "L... "Ranger," (K) "Saratoga," (L) "United States"

...s that a...verted into scrap

...mechani... of the gas, and the torch will cut through so many ...d execu... of metal with the same certainty with which it cuts ...the job, ...h the same number of inches.

Cutting Up Armor Plate

...formed ... the years before the invention of the torch it would ...ilable w... been a puzzling problem to the junk man how to cut ...steel pl... armor plate, ten to eighteen inches thick, into the slab ...ship, ev... suitable for loading into the charging tray at the ...s was s... mills. Today, even the face-cemented glass-hard ...raising ... of such a ship as the "Indiana" can be cut into ...rn on p... by the ship-breaker. Abroad, many thousands of tons ...deck p... heaviest armor have been cut up with the torch, ...o had b... nothing of several thousand guns, from the three- ...mped ... to the huge twelve- and fourteen-inch coast-defense ...y-acetyl... at Heligoland. Most of this experience has been ...eaking ... in Great Britain and Germany.

...e place ... present illustrations of an interesting contract which ...y a sin... recently been carried out at Sandy Hook, where a ...page, 1... known acetylene company of Newark and Chicago was awarded a government contract for cutting a thousand tons of armorplate scrap to charging-box size. The plates, three inches thick and measuring about nine feet by thirteen feet, weighed between seven and eight tons each, and were cut into sections measuring thirteen inches by twenty-five inches, each weighing about three hundred pounds. The cost of cutting up the 3-inch plate was as follows:

Rate of cutting, 19 linear feet per hour.
Oxygen consumption, 13.25 cu. ft. per linear foot cut.
Acetylene consumption, 2.50 cu. ft. per linear foot cut.
Total cost per gross ton (2240 lbs.) cut—$7.50.

A test of cutting a six-inch plate weighing thirteen tons gave the following figures:

Rate of cutting, 13.8 linear feet per hour.
Oxygen consumption, 32 cu. ft. per linear foot cut.
Acetylene consumption, 6½ cu. ft. per linear foot cut.
Total cost per gross ton (2240 lbs.) cut—$7.90.

CUTTING SPEED AND GAS CONSUMPTION OF TORCH

Thickness, inches	Oxygen pressure lbs. per sq. inch	Linear feet per hour, by hand	Linear feet per hour by machine	Cub. ft. oxygen consumed per linear ft.	Cub. ft. acetylene per linear ft.
½"	25	55	73	1.05	0.30
1"	35	40	57	2.50	0.55
2"	45	29	46	6.34	0.96
3"	55	24	41	11.2	1.33
6"	85	15	29	34.8	2.76

In regard to the three-inch plate it should be noted that the amount of oxygen used is approximately 20 per cent in excess of that called for in the company's cutting tables, as grouped above. The acetylene consumption was double that ordinarily required to cut commercial steels, which was due in part no doubt to the fact that the work was done out of doors and exposed to the winds which sweep across Sandy Hook. Furthermore, the cutting was slower than for average steel. This was undoubtedly due to the slag which is peculiar to the metallurgical composition of the armor plate, which contained high percentages of nickel and chrome. This kind of steel yields a heavy, viscous slag that does not flow freely from the kerf in blowpipe cutting. The slag not only retards the cutting speed but calls for higher oxygen pressures than are required in cutting ordinary steel of the same thickness.

As a guide to estimating the expense of cutting up the steel of which the hull and its fittings are constructed, we quote the figures shown in the accompanying table of the speed and gas consumption for metal of various thicknesses as furnished by the company referred to.

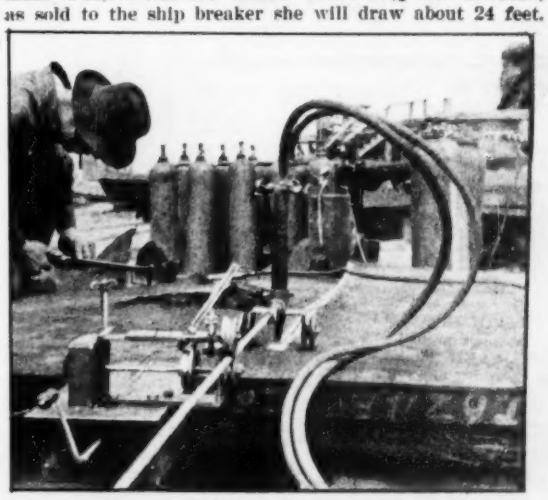
For the more rapid and economical cutting up of the armor plate at Sandy Hook the company's engineers developed the machine shown in the accompanying illustration. For motive power, one of the larger sized spring motors, made by one of the phonograph companies, was used. This serves, through friction wheels, to drive a rod which is extended above and across the armor plate, over the chalk line marking the proposed cut. At the farther end of the rod is a little trolley with three-inch wheels, which carries the cutting torch. The usual phonograph speed control is used, and the speed of travel of the torch can be adjusted at will to suit the thickness and quality of the plate which is to be cut. The greater speed of the machine, as compared with hand-cutting, is attributed to its steadiness, as is also its saving in gas consumption. We are told that it makes a clean, straight kerf, which is the economical cut, and it is found that the unskilled cutter can accomplish as much with the machine as the most experienced hand cutter.

A Suggestion for Ship Breakers

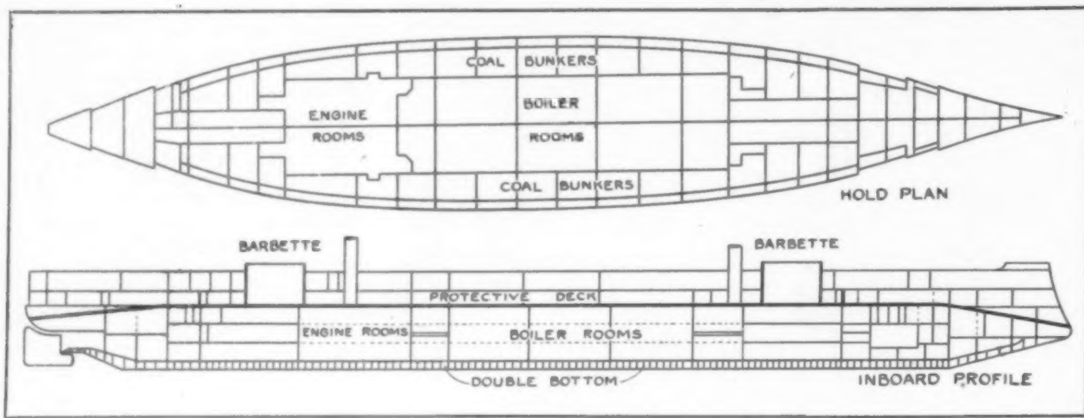
It will not be necessary to do the breaking up at a first-class yard, or incur the renting expense of the largest and most powerful cranes. Any good engineer could design a timber sheerlegs of sufficient height, reach, and strength, to handle all but a few of the heaviest weights, such as the armor plates, boilers, and engine beds, and it may be found possible to reduce these weights by cutting the masses into two or three parts while they are in place upon the ship. The dismantling and breaking up of the ship will go on, of course, from the top downward. The masts, funnels, boat cranes, etc., can be removed from the ship bodily; the chase of the heavy guns can be cut off in short lengths by means of the torch, and the remaining heavy breech portion would have to be removed by crane or sheerlegs.

It will be advisable for ship breakers to cut down to the lowest possible limit the time during which the vessel must be in drydock. As the weights are removed she will, of course, come up out of the water. At her normal displacement of 12,500 tons the "Maine" draws 27½ feet of water; as sold to the ship breaker she will draw about 24 feet.

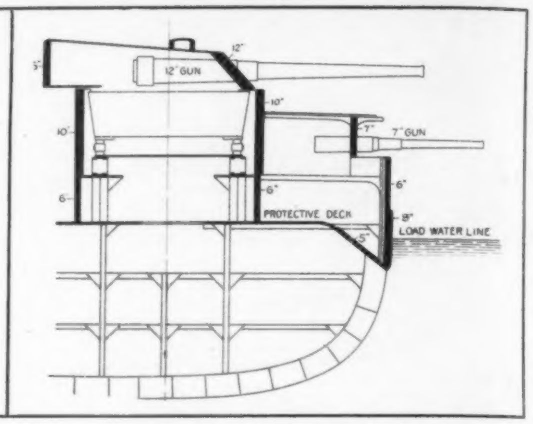
...was u... up 1000 tons of armor at ...y Ho... ground



A machine for holding and traversing the torch, designed for cutting the armor plate



Hold plan and inboard profile of Battleship "Connecticut," showing the elaborate system of compartments



Cross-section through the "Connecticut" at one of the 12-inch turrets, showing armor distribution

By the time her armor and guns have been removed she will come up 5½ to 6 feet more, making her draft, say, about 18 feet. As the successive decks, bulkheads, and hull fittings are taken out and the side framing and plating are cut down, she will continue to rise. In fact, the vessel could be reduced until nothing was left but the double bottom and a foot or two of side plating. Then she would have to go into drydock, where the work could be quickly completed.

The Problem of the Armor

The side armor and the heavy armor on the turrets will be the most serious problem in the whole job. The side armor rests upon a shelf and has a backing of from four to six inches of teak worked in between its inner face and the skin of the ship. It is held against the skin by heavy tap-bolts, which are threaded into the back of the armor and pass through the skin of the ship; and the armor is drawn up snugly against the hull by means of heavy nuts on the tap-bolts; also where the edges of the armor abut against each other there are two vertical slots down the full depth of the armor, into which square keys of steel are driven tightly. To get these out, a heavy eyebolt will have to be tapped into the keys before they can be withdrawn.

Just here a word of warning should be given that it will be inexpedient to use the torch on the outer, glass-hard face of the plates. This face for the depth of one to two inches has been heat-treated and chilled, and the metal is under enormous initial stress. Experience has shown that using the torch on this face is apt to cause the armor to spall off, large fragments flying from the face with sufficient energy to break a man's leg. Hence the cutting will have to be done from the inner face and through the main body of the plate, which is in a more ductile and tough, and less brittle condition. The safe method would be to remove the plates and place them face down on the ground. We have seen that, in the case of a ship like the "Maine," over 2600 tons out of the 9772 tons of steel in the ship consists of armor. The profits to be made in breaking up such a ship will depend not a little upon the intelligence and skill with which the armor problem is attacked. Furthermore, it should be stated that unless the armor is cut into five or more pieces, before removal from the ship, cranes or sheerlegs of from 30 to 60 tons capacity must be provided to transfer the plates entire.

If it were not for the risk to the working crew from flying fragments, due to the spalling of the hard face, the most convenient way to remove the heavy armor would be to cut it up into vertical strips, of slab width, while it was still in place upon the ship. These strips would not be of greater weight than could be handled by cranes of ordinary size; and after removal they could be cut into slab size as they lay upon the dock. But this would necessitate cutting on the outer hardened face; and for the protection of the men, it would be necessary to anneal the armor while it was still in place—a job of no little difficulty.

If the armor could be got at on the inner face, the risk from spalling would be avoided; but to do this it would be necessary to cut through the skin of the ship and remove the wood backing, leaving the armor bolts in place until the cutting had been done. This, also, would be a task of considerable difficulty. Most of the teak backing, however, is only four inches in thickness, and this could be quickly burned away along the line of the cut, leaving the inner face exposed. But if this were attempted means would have to be provided for drawing off the smoke to prevent suffocation. The problem of the wood backing would be encountered on the side armor and on the turrets. There is no backing on the turret roofs, nor is there any on the barbettes or on the protective deck.

In connection with the torch, mention should be made of the electric arc, which has been used extensively in France since the Armistice, in cutting up the steel wreckage of roofs and columns of railway stations, and in removing the wrecked bridges. The oxy-acetylene torch is more portable and is, of course, in more general use for cutting-up work. The arc was employed by the contractors of the East River tunnels of the Pennsylvania Railroad, who used a one-inch, carbon rod, bolted to a copper rod. The best results were obtained with 40 volts, 600 amperes, and a ½-inch to ¾-inch arc. From 300 to 350 rivet heads could be removed in an 8-hour day. In the same time, 4½ feet of 4-inch plate could be burned off. It is necessary for operators to use asbestos masks and aprons and dark-colored eye-glasses.

Burning off rivet heads with the torch

WEIGHT OF MATERIALS U.S.S. "MAINE"

	Tons of 2240 lbs.
Steel hull and fittings	5,178.1
Hull systems—drainage, fire, fresh water, etc.	489.0
Propelling machinery, engines, boilers, shafting, etc.	1,629.6
Wood, including joiner work and wood ceilings	133.4
Armor plate	2,621.9
Guns, main and secondary	628.9
Steel masts, ladders, torpedo tubes, etc.	108.1
Grand total for ship	10,789.0
Included in above total are:	
Brass and Copper	183.0
Joiner Work	133.4
Wood Armor Backing, Decks, Ladders, etc.	444.2
Cofferdam Packing	44.2
Paint	212.4
Total of Non-Steel Weights	1,017.2
Total Steel and Iron in Ship	9,771.8

DETAILS OF SEVENTEEN OLDER BATTLESHIPS TO BE SCRAPPED

	Displacement in Tons	Main Battery		Secondary Battery		Side Armor Inches	Turret and Barbette Armor—Inches	Engines and Boilers*	Steel Scrap in Ship—Tons	Brass Scrap in Ship—Tons
Delaware	20,000	10	12"	14	5"	11-10	12- 8	2 T.E. 14 B&W	14,400	271
North Dakota	20,000	10	12"	14	5"	11-10	12- 8	2 Tur. 14 B&W	14,000	264
South Carolina	16,000	8	12"	22	3"	11- 9	12- 8	2 T.E. 12 B&W	11,840	224
Michigan	16,000	8	12"	22	3"	11- 9	12- 8	2 T.E. 12 B&W	11,840	224
Kansas	16,000	4	12"	8 12	8" 7"	9- 7	12-10	2 T.E. 12 B&W	11,840	224
Vermont	16,000	4	12"	8 12	8" 7"	9- 7	12-10	2 T.E. 12 B&W	11,840	224
Minnesota	16,000	4	12"	8 12	8" 7"	9- 7	12-10	2 T.E. 12 B&W	11,840	224
New Hampshire	16,000	4	12"	8 12	8" 7"	9- 7	12-10	2 T.E. 12 B&W	11,840	224
Louisiana	16,000	4	12"	8 12	8" 7"	11- 8	12-10	2 T.E. 12 B&W	11,840	224
Connecticut	16,000	4	12"	8 12	8" 7"	11- 8	12-10	2 T.E. 12 B&W	11,840	224
Virginia	15,000	4	12"	8 12	8" 6"	11- 8	12-10	2 T.E. 12 B&W	11,400	215
New Jersey	15,000	4	12"	8 12	8" 6"	11- 8	12-10	2 T.E. 12 B&W	11,400	215
Georgia	15,000	4	12"	8 12	8" 6"	11- 8	12-10	2 T.E. 12 B&W	11,400	215
Nebraska	15,000	4	12"	8 12	8" 6"	11- 8	12-10	2 T.E. 12 B&W	11,400	215
Rhode Island	15,000	4	12"	8 12	8" 6"	11- 8	12-10	2 T.E. 12 B&W	11,400	215
Maine	12,500	4	12"	16	6"	11-7½	12-12	2 T.E. 12 Thornycroft	9,772	183
Kentucky	11,520	4	12"	4 18	8" 5"	16½	1.-15	2 T.E. 8 Mosher	9,101	172
Grand Totals of Steel and Brass									199,393	3,810

* T.E.=Triple Expansion. B&W=Babcock & Wilcox.

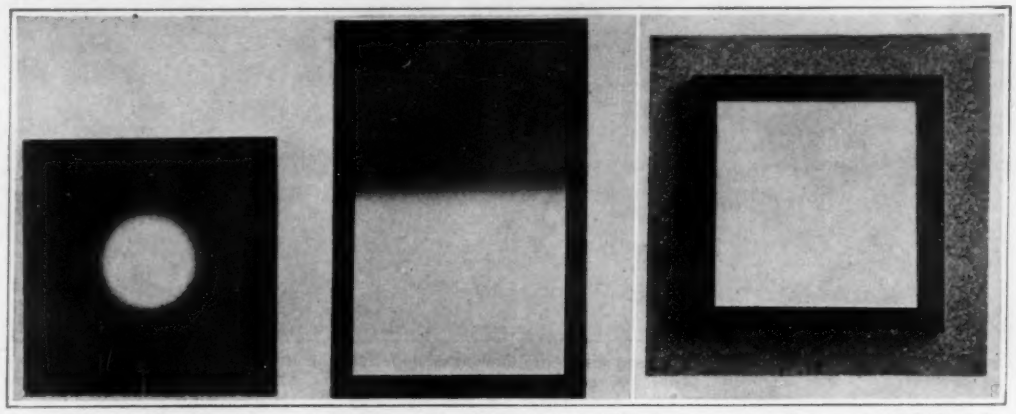
PER CENT COMPLETION AND TOTAL STEEL SCRAP IN THE DREADNOUGHT BATTLESHIPS AND BATTLE CRUISERS

Battleships	Displacement—Tons	% Completion Jan. 1, 1922	Steel-Scrap in Ship—Tons	Brass Scrap in Ship—Tons
West Virginia	32,600	70	15,517	205
South Dakota	43,200	38	11,162	Very slight amount of brass has been worked into these 12 ships.
Indiana	43,200	34.3	10,075	
Montana	43,200	27.6	8,107	
North Carolina	43,200	36.7	10,780	
Iowa	43,200	31.2	9,165	
Massachusetts	43,200	11	3,231	
Battle Cruisers—				
Lexington	43,500	31.1	8,928	
Constellation	43,500	20	5,742	
Saratoga	43,500	32.4	9,302	
Ranger	43,500	3.8	1,090	
Constitution	43,500	12.8	3,674	
United States	43,500	11.8	3,388	
Totals, uncompleted ships			100,161	205
Totals, older battleships			199,393	3810
Grand Totals			299,554	4015

Spectacles for the Motion-Picture Camera

How the Vision of the Lens Is Modified to Produce Fog Scenes and Other Effects

By Charles Alma Byers



Left: Black circular vignette, a graduated yellow filter blending into a half-inch clear center. *Center:* A cloud filter, the upper half, of yellow, graduated to blend into clear glass. *Right:* The fog filter that gives realistic fog scenes, as well as soft-focus, silvery-gray art effects

Some of the things that the cinema oculist prescribes for the camera's eye

"THERE are tricks in all trades," it is said. However true this may be in general, there doubtless are more tricks practiced in the making of motion pictures than in any other one line of endeavor. Many of these have been exposed time and again, but there is one brand of motion-picture tricks about which the public has heard very little, if anything at all.

You have seen, of course, many films in which night scenes have been depicted, and you perhaps have taken it for granted that they were made or photographed at night. Sometimes, it is true, they are photographed at night—by the aid, of course, of strong artificial light; but not always. Many of them, if not the most of them, are actually taken in the bright sunlight of day. "How is it done?" is a very natural question.

You have also seen, no doubt, various fog scenes—pictures in which the screen characters apparently have actually played their rôles in a dense, almost impenetrable fog. To presume that the director has watched and waited for a real fog of suitable density to photograph these scenes is quite natural. Yet he rarely or never does that. The fog effect instead is usually faked. The director's camera man, by a simple trick of the trade, can, in fact, make a better "fog" picture under ordinary weather conditions than when real fogginess prevails.

By way of emphasizing this it is told of a certain director that he was one evening in the midst of the making of a series of "fog" scenes by artificial means, near Los Angeles, when a very heavy fog began rolling in from off the ocean. Presuming the real fog would render the faking of a fog effect unnecessary, he directed his camera man to proceed to a utilization of the real thing, and several hundred feet of film were so exposed. When, however, the film was subsequently developed it was discovered that the faked fog portion came out in lifelike realness, whereas the footage made during the actual fog showed very little of the desired effect. The trouble with the latter was that the fog was in evidence only in the "long-shots" or in the distant background, and not at all in the "close-up" or foreground part of the scenes, while in the faked fog portion the fog evidenced complete envelopment.

Again, the motion-picture patron often sees various vignette effects in the screen-projected picture; also various close-up views in "cut-out" effect, technically known as "iris" and "irinette" effects. Perhaps he or she may have given but little thought to these, in so far as having curiosity aroused. Nevertheless such portions of the picture—variously revealing close-up views, of reduced size, in fading-edged circles, clean-cut circles and ovals, radiant-edged circles, ovals, hearts, diamonds, panels, and so forth—such portions of the picture are produced, instead of in the projecting as perhaps is generally supposed, by a very simple method of "influencing" the vision of the movie-camera eye, the lens.

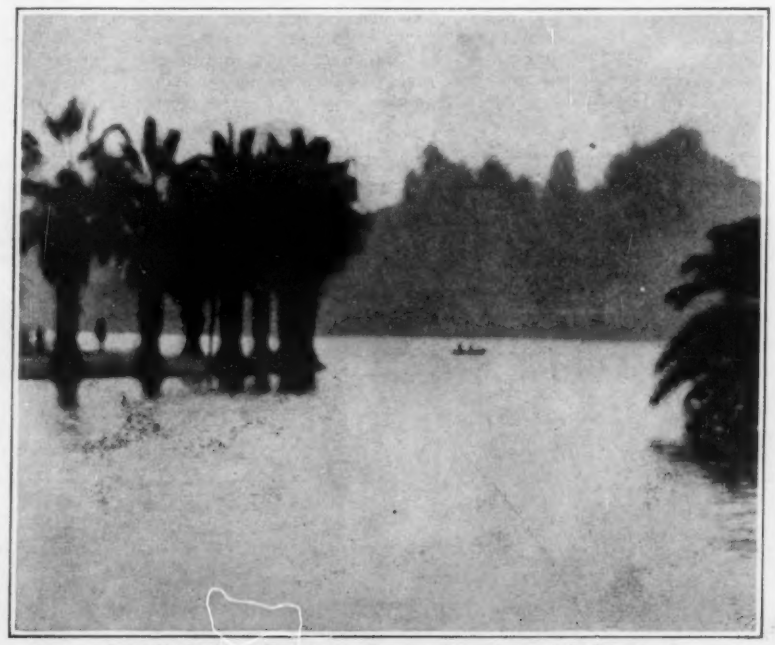
The explanation of all this, simply stated, is that the motion-picture camera, when such pictures are being made, wears spectacles. The lens, in other words, is equipped with or supplemented by various kinds of glasses, known technically as "screens," "filters," and so forth.

In the first place, the small square or rectangle of glass, whether called screen, filter, iris or what not, is placed directly in front of the camera lens, where it is held in position by a special, easily attached or detached, holder. The glass or filter used for effecting night scenes is also used for producing artificial cloudiness. It is a rectangle, about 1¾ by 2⅝ inches in size, with the upper half tinted yellow and the lower part clear glass, the colored portion graduating to disappearance in the middle. It is made in rectangular form so that it may be raised or lowered before the lens to the desired position. The yellow portion is used to cover the sky, which is therefore made non-sensitive to the film. For night scenes, a lowering of the filter not only produces a night sky but brings the graduated middle before the camera lens in such manner as to obscure the lens vision to night-like reality, a "stopping-down" of the camera shutter helping to bring this indistinctness to the desired condition.

The fog filter is a glass about 1¾ inches square. It is, naturally, not wholly transparent, with the result that the picture taken by the lens equipped with it shows a gray or foggy effect. By shortening the exposure time, by means of the shutter opening, the fogginess can be rendered to any degree of density desired. The same filter is also frequently used for creating art-title backgrounds, the background scene so taken being lettered by printing the title matter over it. This equipment may further be employed, for either the "still" camera or the movie camera, for making the so-called "soft-focus" or silvery gray art effects in pictures.

A so-called diffusing screen, however, is generally preferred and used for making "soft focus" pictures. It is the same size as the fog filter, but the glass simulates a screened transparency instead of "cloudiness." The various vignette and "cut-out-center" effects are produced with glasses of the same size which, as may be readily imagined, are appropriately provided with opaque borders and transparent centers.

There remains to be mentioned one more somewhat similar glass, the monotone-filter. This filter is not intended for use as an auxiliary of the camera lens, but is designed for the use of the camera man or photographer to reveal to him just how a certain object will show up in the finished picture. When one looks, for instance, at a bit of natural landscape, a furnished room, or any other scene or object through a camera's ground glass one naturally sees every color and color shade therein represented. The lens of the camera, however, reproduces only in lights and shadows, or in black and white and varying shades of gray. The monotone filter is used to inform the photographer just how the real colors of a scene or object are going to reproduce in black and white; and also, further, to enable him accurately to judge the value of light, whether natural or artificial. In other words, by holding it before his eyes this glass enables the photographer to see the scene or object exactly as it will appear in the finished photograph. This so-called monotone filter, incidentally, is sometimes rendered into a plain rectangle or square, sometimes into a monocle, and occasionally into ordinary spectacle style. It is used, it may be added, not only by the camera man, but also by the director in selecting furniture or other paraphernalia, including the costumes of the actors, which is to be used in the motion-picture "set."



A realistic fog effect, staged on a day of crystal clearness

The Organic Chemistry of Soils

THE study of some notably infertile soils and of very productive soils of the same type which had been held under what we call "better systems of farming" revealed the presence of certain toxic organic compounds in the one which were not present in the other. This has led to a study of the organic chemistry of the soils. We succeeded in separating from soils some 35 definite organic compounds, some of which were beneficial to certain crops and some of which were toxic to certain crops and nontoxic to others. It was also found that soils under a certain condition of aeration would yield certain organic products and under other conditions of aeration other organic products. It was found that the compounds separated from the soil were of the same nature as the compounds in the digestive system and in the blood of man and animal, and it was finally realized that the soil has a digestive system, as it were, and breaks down organic materials such as the proteins, carbohydrates, and fats much as they are broken down in the digestive system of animals. The soil has the same kind of bacterial, enzymatic and exidation processes as are common to the animals. It is evident that soil through these digestive agencies will take care of the excreta of plants and the organic matter that accumulates in the soil from various causes, reducing the organic matter to lower and lower forms of oxygenated bodies until they approach the hydrocarbon type of compounds in our humus, which are stable, innocuous and form the sewage disposal of the soil.

In the animal under abnormal functional conditions the too great accumulation of products of metabolism causes a fatigue of the muscles or if the system can not eliminate them the death of the animal. Under abnormal conditions the soil becomes fatigued and the plant is unable to function.—Note from article by Dr. Milton Whitney, U. S. Dept. of Agriculture, *Science*, Oct. 14, 1921.

Revising Street Intersections With the Aid of a Model

ON account of the views obtainable from their slopes some of San Francisco's hillsides are extremely desirable as residence sites. Unfortunately, however, little thought was given to the topography by the surveyors who first laid out the city. One set of streets was run parallel to the meridian and another at right angles thereto. The fact that this gridiron plan would later necessitate grades as steep as 55 per cent on some streets and thereby detract from the value of adjoining property apparently was overlooked until many years later.

The model which aided the San Francisco city engineer in remodeling the intersection of 17th Street and Roosevelt Way. Many similar problems, arising from San Francisco's extremely heavy grades, have been similarly handled

To eliminate, at a minimum cost, as many as possible of these excessive grades has been the policy of the city authorities. No standard plan has been adopted, but a separate study is made of each case.

For the purpose of visualizing these improvements for the benefit of the engineers and the property owners, models are made as shown in the accompanying view. These not only help the engineers in studying the problems which would be confronted in actual construction, but enable the property owners to see just how the work will look when completed, which helps the city authorities in getting the consent of the property owners concerned with the improvement.

Our illustration shows the first stages in the construction of these models. Cardboard is used, being bent into shape and marked with the names of the streets intersecting and the grades. If desired a clay model can later be built up on the cardboard base.

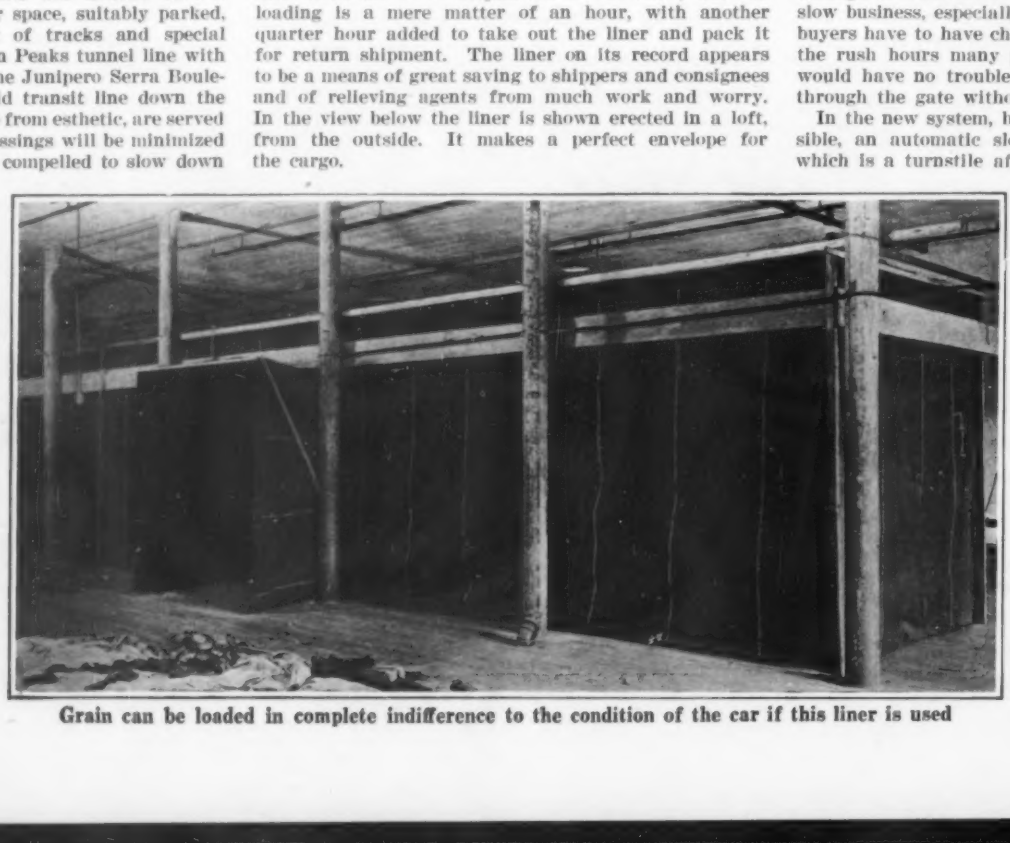
One of the cardboard models was used with signal success in the work of coordinating at a common point of intersection the main thoroughfares south and west of Twin Peaks; Juipero Serra Boulevard, Sloat Boulevard, West Portal Avenue, Portola Drive, and St. Francis Boulevard. A satisfactory design was worked out for the meeting of these boulevards to prevent congestion of automobile and street car traffic, and still give a scheme in harmony with the high-class residential districts developed and planned for the immediate and the distant future.

The plan provided a circular space, suitably parked, within which is the network of tracks and special track work connecting the Twin Peaks tunnel line with the existing Sloat Boulevard, the Junipero Serra Boulevard tracks, and a future rapid transit line down the peninsula. Two purposes, aside from esthetic, are served by this circle. The railway crossings will be minimized and automobile drivers will be compelled to slow down to make the sharp curve in absolute safety.

The Freight-Car Liner

MUCH has been said about the loss due to loading of loose grain in bad box cars, and the railroads have in some cases actually been obliged to enforce a regulation against such loading, requiring the grain to be in sacks. We have shown in the past several devices intended to remedy this situation and make loose box cars tight. We now illustrate one which has the specific indorsement of one of the western railroads, to the extent that owners are allowed to ship, at their own risk, loose grain in a car equipped therewith, the regulation against such shipping being suspended to permit employment of this method of economical shipment.

This "car-liner," as the inventor aptly calls it, is just what the name and the picture indicate. The liner is of army canvas, and covers the sides and bottom of the car. It is in a single piece, so that there is no necessity for sweeping out the last of the grain in unloading; it is taken out with the liner and shaken down. In the most unfavorable cases the liner has been installed in three-quarters of an hour; and unloading is a mere matter of an hour, with another quarter hour added to take out the liner and pack it for return shipment. The liner on its record appears to be a means of great saving to shippers and consignees and of relieving agents from much work and worry. In the view below the liner is shown erected in a loft, from the outside. It makes a perfect envelope for the cargo.



Grain can be loaded in complete indifference to the condition of the car if this liner is used

New York's new slot-machine scheme for paying subway and elevated road fares without the delay of buying a ticket

Cliff Improvements at Folkestone

AN example of the practical utility and artistic possibilities of concrete and reinforced concrete in a somewhat unusual direction is afforded by some works which have lately been carried out on the undercliff at Folkestone, England, by Mr. A. E. Nicholls, the borough engineer. Among various improvements projected, the first undertaken was a pathway of easy gradient giving much needed access between the Leas and the Undercliff Drive. In order to protect the sandy and friable soil between outcrops of Kentish ragstone on the line of the new path, artificial rocks of concrete have been constructed, the texture and coloring being such that it is almost impossible to distinguish between the natural and artificial formation. The concrete work, continues *The Times Engineering Supplement*, is built up from footings, 20 feet or more in depth at some places, and is monolithic throughout. An interesting feature occurs at a point where two lengths of the path run one over the other, the lower one being carried through a tunnel the walls and roof of which are strongly reinforced. Ample provision has been made for the growth of rock plants and vegetation, and it is expected that the appearance of the work will become even more pleasing than it is at present. This improvement at Folkestone should serve the purpose of encouraging a use of concrete which has been applied in the United States far more extensively than in England.

Drop a Nickel in the Slot, and Ride

RECENT issues of the "Subway Sun" and the "Elevated Express," the news sheets which are posted in the trains of New York's rapid transit system as a means of bringing the company's problems and its activities home to the riders, have informed the people who make daily pilgrimages from Dyckman Street to Park Place or South Ferry that there will be no more necessity for standing in line to buy tickets. The system heretofore has been for the passenger to buy a ticket at the window and walk five or six steps to the platform entrance, where he dropped the ticket in a chopping box and passed through to wait for his train. Selling tickets is rather slow business, especially when a good proportion of the buyers have to have change made for them, and during the rush hours many people miss a train which they would have no trouble in catching if they could pass through the gate without delay.

In the new system, being installed as rapidly as possible, an automatic slot machine stands at the gate, which is a turnstile affair instead of being wide open as in the past. The dropping of a nickel releases the turnstile for a quarter-turn, just enough to let one passenger through. If the prospective passenger hasn't a nickel he must get change at the change booth in the rear. It is believed that far fewer people will have to patronize these than before, since under the old scheme even if one had a nickel one had to stop to exchange it for a ticket. The person who does not care to bother about carrying a supply of tickets can perhaps convince himself more easily of the advisability of having one or more nickels among the contents of his change pocket. The possibility of having two turnstiles in charge of a single platform man is also in favor of the new system.

More Comfort with Less Work

A Survey of the Latest Devices That Tend Toward Placing Country Life on a Par with City Life

MODERN civilization has showered all manner of comforts upon us on the one hand, but on the other it has robbed us of much of that physical endurance and strength and even resistance to sickness enjoyed by former generations. This softness, to fall back on the colloquial, is most marked in city dwellers, who are accustomed to exceptionally warm apartments, hot water on tap, no outdoor tasks and chores, practically no physical effort, little or no walking. So habituated has the present-day city dweller become to all these comforts that he fails to realize his softness until he has essayed the rigors of country life. And it is at this point that we begin our present discussion.

Various causes which need not be repeated here have turned the tide. A few years ago the current of population flowed from the country to the city, because of the industrial opportunities that went begging for lack of help and because of the fascination of metropolitan life. But in the present industrial depression, coupled with the unsatisfactory rent situation, overcrowded dwellings and other recent conditions, the tide has set the other way and we find not only the original native of the country returning to his former haunts, but also a large proportion of heretofore dyed-in-the-wool urban dwellers who have decided to renounce city life — at least for the moment.

A Turn in the Tide

So we have a situation that calls for the remodeling of country life, especially in the suburbs and even in localities within a few hours' ride of the centers of population. The one-time city inhabitants will insist on modern plumbing. They want running water; if there is no water supply system, they will install a pumping outfit and reservoir. They want electric lights—oil lamps are absolutely passé; and if there is no electric light system within ready reach, then they will install an isolated electric light plant. They want hot water; stories of how our fathers and mothers broke the ice on top of the basin of water in order to indulge in their morning ablutions are interesting as relics of a past age, but today we want hot water on tap for washing, shaving and the dishes. They want plenty of heat; there was a time when fireplaces were intended for heating purposes, but today the fireplace is just an added decoration for the living room, and serves as a display stand for a collection of ornaments on its shelf and an assortment of andirons and other utensils on the hearth. Today an efficient heating plant is part and parcel of any country dwelling that has any pretensions to being modern.

The heating of the modern country dwelling falls into three broad classifications. There is the hot-air method, in which cold air, drawn from the outside, is circulated about a heated stove and by its own impulse distributed upward through various large pipes. Then comes the steam plant, in which steam is generated in a boiler and distributed through pipes to radiators placed at the desired points throughout the house. Lastly, there is the hot water system, in which a constant circulation of hot water is maintained through a continuous and closed piping system connected with a boiler.

A Question of Choice

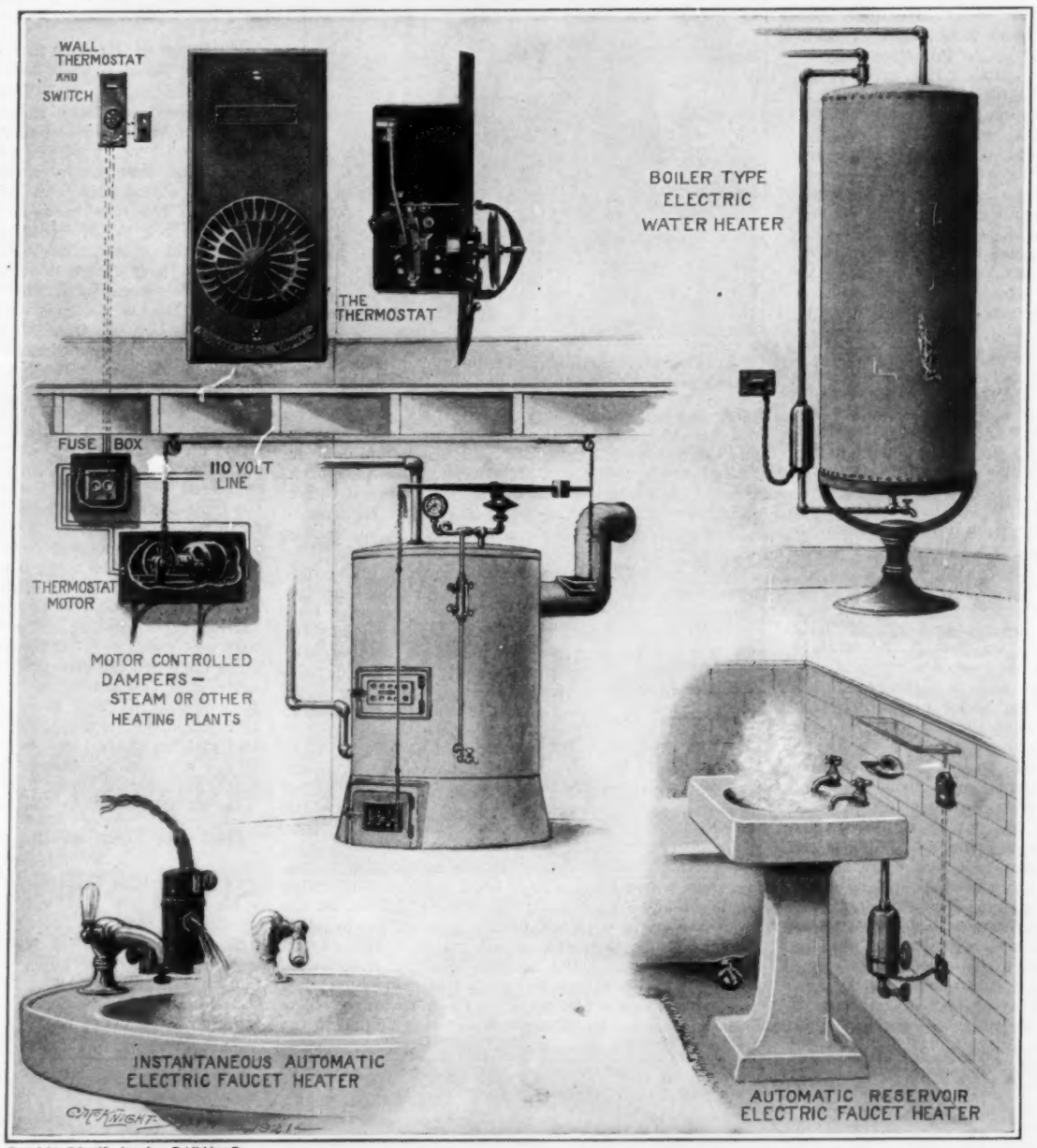
The hot air system has been largely superseded by the steam and hot water systems in the more modern homes, because of its dust and dirt. No matter how careful the operator may be in shaking down the usual hot air installation, the ashes generally get into the hot air ducts and are scattered in the form of fine dust throughout the house. Then the usual hot air furnace is larger than the corresponding steam heat or hot water installation; consequently it involves more physical effort than the more modern types. However, it has certain definite advantages, aside from its low cost. Most important of all is the fact that it can be readily started and regulated. Thus in the late spring and early fall the hot air furnace can be started and operated for a few hours with a few pieces of wood, just to take the chill and dampness out of the house.

The steam type of heating plant is nothing if it is not neat—at least as heating plants go. It is relatively small, compact, and readily attended to. The hot water is, if anything, even better, and seems to be the favorite in the dwellings now being built.

It would be reckless, however, to state that the hot air type is going out of style. Here and there one comes across experienced builders and plumbers who insist that it is still the best system. By way of proof they lay great stress on the ease with which it can be started and controlled, its fool-proof properties, and the fact that it draws in fresh air from the outside and thus combines excellent ventilation with heat.

Of late there has appeared the pipeless type of hot air furnace. The design of this type is such that instead of taking in fresh air from outdoors and sending the heated air up through the pipes a circulation of air is created within the house itself. No pipes are used. Only one huge register is employed, through which the heated air passes out and rises to every part of the small house, while the cold, heavier air sinks and passes down through the register to be heated again and circulated through the house. Hence it will be noted that the same air is used over and over again. Obviously, there must be some economy in a scheme of this kind, since the air that is used over and over again does not have an opportunity of getting very cold and therefore is more readily heated to the desired degree, in marked contradistinction with the usual hot air furnace which takes in cold air from outdoors. Excellent results are said to be obtained in small homes, where a circulation of air is readily effected.

However, after all is said and done, the question of heating plant is largely one of choice, and also of specific conditions. What proves excellent for one kind of house may prove inadequate in another. The human element, too, counts for a good deal.



The greater part of this drawing is taken up by the thermostatic control for the usual household heating plant. The thermostat, placed in any room, can be set for any desired temperature, and the heating plant is automatically regulated for that temperature. The other views show various types of instantaneous automatic reservoir and boiler types of hot-water heaters

A few of the electrical heating devices which make country life well worth while

From Heavy Coal to Dusty Ashes

No matter what heating system is employed, coal is generally used. Coal has many excellent points in its favor. It is readily obtained in almost all localities, for its distribution is virtually nation-wide—at least where there is a genuine demand for coal. It burns well and requires a minimum of feeding as compared with wood. But the one great drawback about coal is the ash which it leaves under the firebox. The ashes must be disposed of, and herein is one of the meanest tasks to be found about the small home.

On the average one can count on a barrel of ashes every two weeks. Formerly the heating plant had no provision whatsoever for the accumulation of ashes, and one was compelled to take the ashes out from under the firebox and either take them out of the way then and there or pile them up in a corner of the cellar or

store them in a barrel or box. The modern trend, however, is to provide an exceptionally large ash pit under or near the heating plant where ashes over a long period of time can be allowed to accumulate, and their removal can be done in sufficiently large quantity to warrant the effort.

Realizing the work and dirt involved in burning coal, there have been not a few efforts of late to introduce fuel oil for home heating plants. The idea is by no means new, true; but it has taken years of study and experimentation to develop an oil-burning mechanism that would function with precision and would not clog itself up with a surplus of carbon. Judging from the oil-burning equipments now being offered, it appears as though the problem has at last been satisfactorily solved, and that in time coal, with all its dirt and ashes and hard work, must be banished from the American home.

Ordinarily fuel oil is the cleanest, most convenient and most satisfactory form of fuel for heating, now that there is available a simple, practical and durable machine which burns it without noise, odor or dirt. The market price of fuel oil up to this time has remained around 5 cents per gallon. But even at 10 cents per gallon, heating with fuel oil will be found a much more desirable proposition and no more costly than the old method of heating with coal.

For instance, one of the smaller-sized oil-burning machines—capable of heating the average ten-room residence—can be turned down so low that its fire will consume not more than one-half gallon of fuel oil per hour. Please realize what this means: on a mild winter's day, when the fire is turned low, it would require only about 12 gallons of oil for 24 hours' heating. At 4 cents per gallon this would be less than 50 cents for fuel for heating the home one whole day and one whole night.

On the other hand, when a large hot fire is needed it can be had instantly and as simply as turning on the electric lights. It takes only two or three minutes to light the fire when the boiler is equipped with the oil-burning machine, and the fire is hot as soon as it is lighted. Therefore, the fire can be completely extinguished without any of the previous dread of rebuilding same.

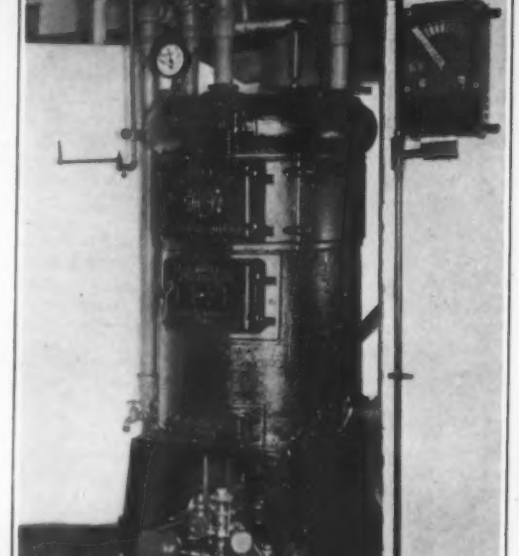
Explanation of how simply one of these oil-burning systems does the work is interesting in conjunction with the accompanying photograph, which shows the oil-burning equipment alone.

The Ultimate Home Fuel

The oil is drawn from the supply tank, which is placed under the cellar floor, up through the strainer and through the pump, which is located at the center of the accompanying view. The oil is then forced into the pressure chamber and is kept under pressure by the pump. Oil now passes upward through the revolving needle-valve seat which regulates the quantity of oil to be burned. From this point the oil flows downward to the bottom of the revolving cup of the atomizer, where centrifugal force throws it through the tube of oil, which is held in place by centrifugal force. The oil to be burned, therefore, has time to be separated from the dirt, water and other substances and all find their logical positions, according to their specific gravities. So efficient is this system of sorting out dirt, water and other foreign substances from the fuel oil that a small-sized burner in a home ordinarily need not be cleaned oftener than once in two weeks.

But even with the use of fuel oil the small home occupants are not relieved of the task of attending to the regulation of the fire. Here is where another device comes into use—the thermostatic regulator. The most important requisite and one which should never be overlooked in the heating of any building is the regulation of temperature. A system of heating may be ever so good, but if the regulation is poor the comfort and health of the occupants suffer.

The essential feature of any temperature regulating system is the thermostat itself, which must be sensitive enough to operate under very slight changes of temperature, yet rugged enough to stand the service required. There are various kinds of thermostats, but fundamentally they all come down to some mechanism which is effected by the slightest



Oil-burning machine installed in a typical home heating plant. Note the simplicity of installation

changes of temperature in such a way as to make certain electrical connections which in turn cause one or more electric motors to regulate the drafts and damper of the heating equipment. The remarkable part of a thermostatic control is that the temperature can be set for any desired degree, and the thermostat then automatically takes care of the heating system and holds it to that temperature.

The thermostatic control system shown in the accompanying drawing makes use of a temperature-sensitive element, consisting of a double-diaphragm chamber containing a volatile liquid. The front wall transmits its motion to a lever arm, which in turn operates a switching mechanism opening and closing an electric circuit. The electric circuit in turn operates the various members of the heating plant as shown in another sketch.

Hot Water without a Fire

As for hot water, many schemes have been put forth of late. Of course, in the past the usual source of supply for hot water has been the kitchen range, which is provided with a water heater that operates without the expenditure of fuel other than that used for heating and cooking. In the case of homes equipped with gas, ingenious water heaters have been introduced in which a pilot light burns steadily and serves to flash on the large burner, as a faucet in any part of the house is turned on. In this manner hot water is virtually on tap—it only takes a few minutes to obtain it.

In homes without gas, especially in summertime when a coal range can not be operated, the hot water problem is more serious. In this case resort may be had to the several excellent oil-burning water heaters. The trend, however, is distinctly toward electric water heaters, of which several types are shown in the various sketches. One type is fastened right on the faucet and is provided with a switch for controlling the heat. Water is heated the moment it flows through this heater, which consumes only 600 watts, or no more than the usual electric iron. Another type is connected to the usual hot water boiler, and serves to heat 25 or 30 gallons of water which is stored in the boiler, ready for use. This type of heater consumes in the neighborhood of 1200 watts, and is provided with renewable heating units. Still a third type is the automatic-reservoir faucet-heater, which heats a small quantity of water and maintains it at a given temperature, ready for use at any time. The usual capacity of this water heater is five gallons.

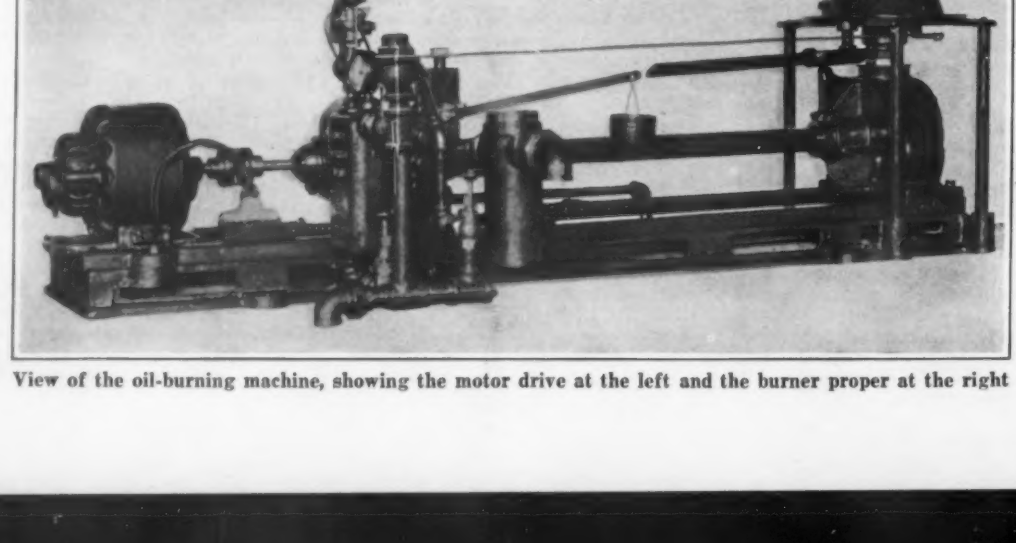
All in all, country life is not what it has been. The time is fast coming when the country resident will enjoy the same comforts as the city dweller, with a great many more pleasures as well.

Failures of Bronze and Iron Bell Clappers

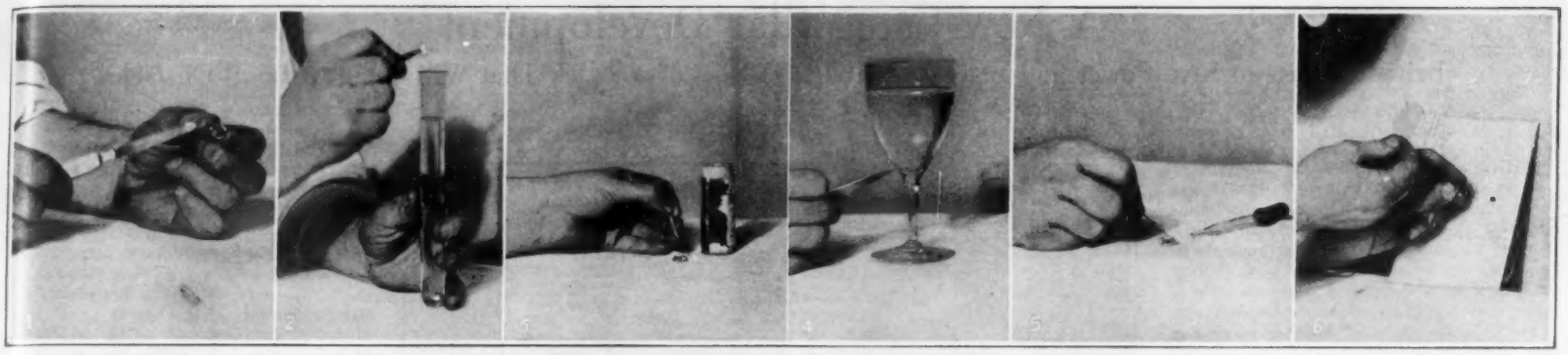
SOME failures of church-bell clappers induced a member of a large German steel foundry to experiment on the behavior of steel rods under conditions similar to those to which a bell tongue would be exposed. He observed that many of the specimens broke, although quite sound near the fracture, in a way for which an adequate explanation had not yet been found. He suspended his rods between two blocks of cast-iron which the rod would strike when deflected 45 degrees to the right or left. The suspension was by means of a leather loop fastened in the first series of tests round screw bolts fitted into the upper forked end of the rod. Most of the rods were club-shaped, thickening toward the bottom. The first rods broke across or near the bolt holes, after 90 hours, corresponding to 185,000 double blows. When the bolts were replaced by cast-on lugs, the fracture occurred after longer service, 220 hours, and lower down, near the point where the rod began to thicken. The material was superior mild steel; an exceptionally good nickel steel lasted longer, but broke, too, finally. Two well-known experts both suggested that it would be more advisable to reduce the cross-section in the middle portion of the rod than to increase the section. Long flat rods, not specially weighted at the bottom, were then tried. They lasted 500 hours, but when a small indentation, about 0.5 mm. deep, was made nearly halfway down the rod, with the aid of chisel, the rod broke across at that spot on further experimenting. Then a kind of flat bar pendulum was used, oscillating with its greatest section at right angles to the direction of motion; this also lasted more than 500 hours, but then developed a crack on the one side, halfway down. One expert recommended this shape, *i.e.*, a clapper with a long, relatively thin and yielding shaft. One would think the failure would be due to resonance effects. The fractures did not indicate any deformation or flaw of the materials nor any want of homogeneity. The tests are severe, of course.

How the Color of the Ground Affects Plant Growth

SOME curious experiments as to the effect of the color of the soil were recently described in the French journal *La Traction Moderne*. These experiments were made in a vineyard. The surface of the soil was lightly covered with reinforced concrete, a suitable space being left vacant around each vine stock. One-third of this concreted surface was painted white, another third ochre red, and the remainder black; the results were very remarkable, since in those plots which had been painted red and black the vines were twice as vigorous as on the white plots. The reason for this is that the temperature of the ground is considerably higher in those areas having either a red or a black color, and this increase of temperature has an immediate effect upon the growth of the plants. These studies throw light on the superiority of the soil of certain territory, such as the black earth in Morocco. It has been noted, too, that the earth in some of the best grape-bearing localities in the South of France is either reddish or black, and this no longer appears as a mere accident.



View of the oil-burning machine, showing the motor drive at the left and the burner proper at the right



1. The file will make an impression upon a false diamond, while it will not touch a genuine one. 2. The chemist has a simple means of causing a fake diamond to burst, by a process that will not harm the real gem. 3. Hydrofluoric acid will dissolve an imitation, but will have no effect upon true diamond. 4. The real diamond will shine with some brilliancy when immersed in clear water; the paste article is entirely dull under these conditions. 5. On a true diamond a drop of water will hold its globular shape, much as quicksilver does; on a fraudulent stone it will "spread." 6. A real diamond can be used as one of a pair of lenses, and will give sharp focus; the paste stone will never do this

Six simple tests that will separate the imitation diamond from the genuine stone

To Put a Diamond to the Test

A VARIETY of tests may be advisable for one who is not an expert judge of diamonds; and even one who is, an imitation may leave temporarily puzzled so that some mechanical or physical test is resorted to. The old test of cutting a piece of glass with the stone under investigation is now reversed, though with an additional variation. A file takes the place of glass, and the rasping edge of the little tool is brought against the sparkling surface of the gem under suspicion. This is an attack no impostor can survive for a single instant. No impression, of course, can be made on a genuine diamond.

Another test even more severe consists of the following procedure: The stone is covered with borax, heated and then dropped into a receptacle containing cold water. Glass or similar imitations will be shattered, but a diamond comes through the ordeal unharmed.

Cleopatra may have dissolved her pearls in vinegar so as to make a priceless drink, but the vinegar of that day must have been exceptionally hard on the lining of the stomach if it could perform so astounding a feat. But today your diamond (if it be spurious) can be readily dissolved. Hydrofluoric acid will turn the trick for you. A genuine stone, of course, is immune to this test.

There are two tests with water that are equally interesting in demonstrating whether or not you have been imposed upon by some trickster when you decided that nothing but a diamond would complete your happiness. One of these is simply to drop the stone in a glass of clear water. The stone, if it is a genuine diamond, will still continue to radiate some of its brilliancy, but a "paste" will have practically lost all of its glow and luster.

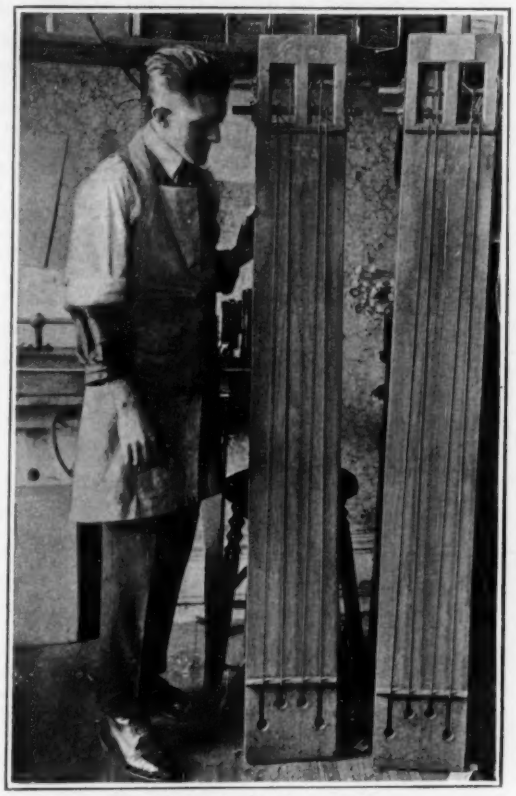
The second water test consists in putting a drop of water upon the stone's surface and moving it about with the point of a pin. With a diamond the drop will remain globular and hold together after the manner, somewhat, of a particle of "quicksilver." But on glass the drop will spread.

Some of these tests, it will be noted, are purely chemical ones. If directions are followed nature's forces do the rest. Others depend in a measure upon careful use of the fingers, but a final test depends upon the eye solely. Take a sheet of white paper, and upon this make a round black point with a pencil. Then hold the diamond a short distance away from this point with the left hand, while with the right hold a glass and through this get the stone in focus with the pencil dot. If the dot can be seen clearly the stone is a diamond; but if there is a fogginess about this pencil point or if several pencil points appear, the stone is an imitation.

Musical Strings and Where They Come From

THE string choir is often called a "string quartet," but this is not strictly accurate, as we now employ five instruments in this division of the orchestra: first violin (soprano); second violin (mezzo soprano); viola (alto or tenor); violoncello (tenor or baritone), and contra bass (basso). The violin is undoubtedly the "king of the orchestra" and is, in truth, the brilliant prima donna of the wooden stringed instruments, whether for coloratura or dramatic effects. The viola is an older instrument than the violin and is much esteemed. The violoncello is a development of the old "knee fiddle" and the stately double-bass furnished a firm foundation for the lighter sisters of the string choir.

Formerly strings were made of catgut, but in reality



Stretching double bass strings

the modern strings are made from the intestines of sheep or from wire, and may be either plain or covered. Gut strings are used for other instruments which do not belong to the noble family which we have enumerated, such as the banjo or harp, where the fingers are used, or where a pick is used, as on the mandolin. Metal strings are used for all instruments which are struck with hammers, mallets, etc., such as pianos, zithers, cymbalums, etc.

Each string in a violin is of a different thickness, according to the tone and tension required. The fourth string is covered with fine wire, either a white metal or real silver, hence it is often called the "silver string." Violas, violoncellos and double-basses have each two covered strings, the object being to insure a sufficient gravity of tone without having too clumsy a material. The covered strings on the guitar are upon a basis of silk instead of catgut. The best gut comes from Italy, which has been famous for centuries for this product. Strings are carefully selected and graded as to size so that they shall be uniform. The larger strings for the bigger instruments are stretched on frames for three or four days as shown. The covered strings are finished on a special lathe which covers them with floss silk or fine silver-plated copper wire, or even silver.

The instruments of the "string choir" are all played with a bow, with occasional pizzicato, or plucking of the strings, as required by the music. A bow is an instrument of wood and horsehair employed to set the strings of the violin or other musical instrument in vibration. As its name implies, it was originally curved. The violin bow is usually about 29 inches long and the stick has a slight curve inward. The violoncello bow is a little shorter. The double-bass bow has a large arch and is shorter. The early bows were so crude that they added little to the delicacy of tone. The earliest improvement was made when a metal band with teeth-like edges was introduced with the design of regulating the position and tension of the hair at or near the handle. It was reserved for Francois Tourte (1747-1833) to devise the plan of keeping the hair flat by means of a clasp, and the screw and button for slackening or tightening the hair at pleasure.

The horsehair comes largely from Russia and the upset conditions of the last few years have had their effect on the product, much to the disgust of the musician. South America was looked to for the supply when that from Russia was cut off. It is, however, only a question of time when the Russian ranches, where the horses are bred for the purpose, will continue their supply with something like the old-time quality. The primary sorting of the hair takes place at the ranch from which it goes to the bleacher, who bleaches the hair with sulfur. It is then bound up in hanks of 100 to 150 hairs, and the hanks are then ready for export. One hank usually goes to a bow. On arrival at the bow factory or the repair room of the large dealer the hair is combed out and fixed on the end with shellac as illustrated. All work of this kind is strictly hand work and a factory in the ordinary sense of the word, with its dozens of men, is unknown to this queer trade; two or three workmen are usually all that are required. The workmen insert the hair in the top end of the stick with a wooden plug. The hair is then straightened out by means of a special comb and fastened into the frog at the lower end of the stick. A professional violinist has to have his bow repaired every two or three months, and the cost is usually one dollar, so nobody will every get rich on this; but if the virtuoso wishes to be reckless he may buy a "G" string covered with gold wire.

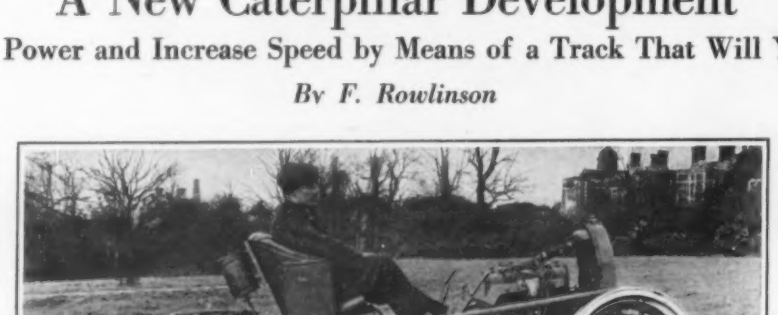
Hairing violin bows in a typical musical instrument shop

A New Caterpillar Development

British Efforts to Save Power and Increase Speed by Means of a Track That Will Yield to Local Obstacles

By F. Rowlinson

THE "caterpillar vehicle," as the type of machine which lays its own tracks has been christened, has not made the commercial headway which its many theoretical advantages have led enthusiasts to predict. It is true that for agricultural use, and in undeveloped countries where transport facilities are non-existent, and also in some cases of locomotive cranes for work on soft ground, the track-laying vehicle has had a fair degree of success. Also during the war the successful development of the tank, both in the heavy armored types and in the lighter whippet vehicles, was certainly dependent upon the caterpillar track. But in the early tank designs much trouble was experienced, and many failures, because the knowledge of caterpillar-track design was fragmentary and incomplete. These early tank designs were experimental, and from them much important data was evolved to serve as a foundation for later experimental work on peace-time designs. So the development of the tank in its various forms gave a great impetus to the design of track-laying machines generally. None the less, even the most ardent advocates of caterpillar machines on theoretical considerations confessed themselves disappointed by practical results. For instance, in competitive trials of agricultural tractors in England the caterpillar types evinced no overwhelming superiority over those types employing ordinary wheels.



An ordinary passenger car converted to the caterpillar type

With the object of overcoming the inherent difficulties of the design of caterpillar vehicles a recently developed type of caterpillar track has been experimented upon by the British Ministry of Transport. This new type of vehicle tackles the problem from a novel point of view, and some remarkable results have been obtained.

The theoretical advantages of the caterpillar type of machine lie first in its ability to carry heavy weights without imposing upon the ground any great superficial pressure. In other words, the weight is (theoretically) spread over a very large *area;* with a wheeled vehicle the support is more of the nature of a *line* support. This is the theory; in practice it is found that on soft ground the ordinary wheel sinks in until a sufficiently great area is buried. When the superficial pressure on the ground is reduced to a degree which the ground will bear, sinkage of the wheel ceases. But the wheel always has opposed to it an inclined plane, as it attempts to climb out of its rut; the inclination of this plane depends upon the depth to which the wheel has sunk (which depends in turn upon the width of the wheel track) and the size of the wheel. The remedy is to widen the wheel track as far as practicable, and to increase the size of the wheel. The caterpillar track, as usually built, is equivalent to a very wide wheel, with a very large diameter, the lower track performing the same function as a portion of the rim of a wheel perhaps 100 feet or more in diameter. For soft ground this theoretical advantage is only realized partially. Were the ground perfectly plane and free from local unevenness, then practice would agree with theory. But as no ground (at all events, no ground for which caterpillar vehicles are necessary) is free from local obstacles, it frequently happens that a machine designed to distribute its weight evenly over a large area has, at a particular moment, as much as half of its total weight concentrated on a very small obstacle. The result is to crush the obstacle if it is soft, or to jar the whole machine if it happens to withstand the weight. In neither case is the theoretical advantage of the caterpillar track realized. For if the obstacle is crushed energy is absorbed in crushing it, and the measure of inefficiency of the track system is found in the crushed smooth rut it leaves behind. If no crushing takes place, then the whole mechanism, with its heavy load, is subjected to a violent shock as it passes over the obstacle.

The first essential, then, of an efficient caterpillar track is that it shall yield *locally* to small obstacles; the second that such obstacles shall not be called upon to withstand any greater superficial load than the ground under the rest of the track. If we examine existing types of tracks as commercially developed it will be found that *local* flexibility of the track is either entirely absent, or else so small as to be negligible in practice. We shall see later how this defect has been overcome in the latest experimental vehicles.

One result of the failure of the ordinary type of track to yield to local obstacles is that the multitudinous pins, links and joints which compose the ordinary track have all to be designed to take very great loads and shocks. Moreover, the multiplicity of these

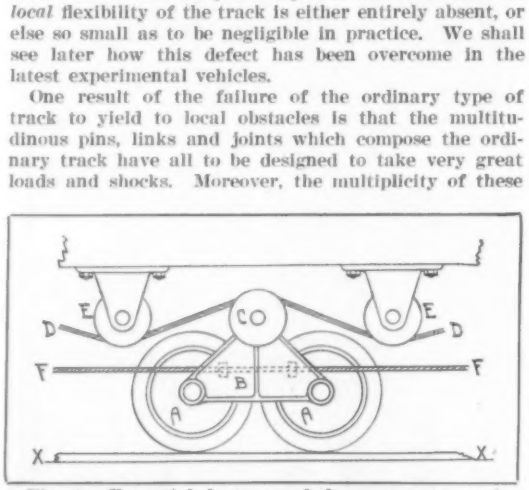


Fig. 1. Essential features of the newest type of caterpillar suspension, developed in Great Britain

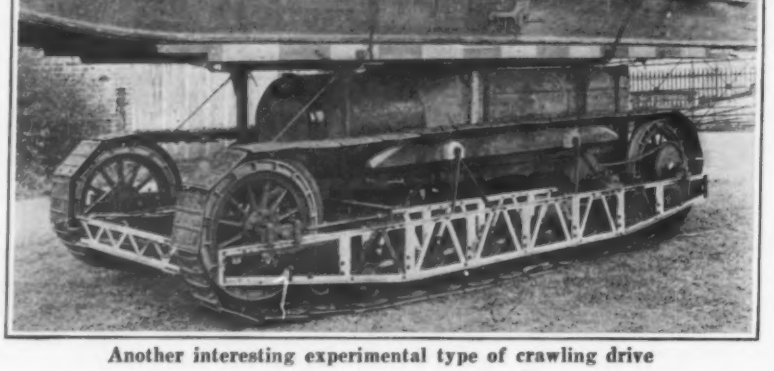
pins, links and joints is in itself a serious drawback, both in first cost and in maintenance. They can never be efficiently lubricated, from the nature of the work they have to do, and the ground they have to cover; and at the best it is found that their chief lubricant is liquid mud. Consequently their replacement costs loom very large, and this, in conjunction with the heavy prime cost, makes the use of such types of vehicle prohibitive for ordinary commercial operations. We arrive therefore at the third essential of the ideal track, that it should be simple, with as few joints, pins or links as possible, and that these should be amply lubricated. From the third desideratum we arrive at the fourth—efficiency. The mechanical efficiency of the ordinary caterpillar track is lamentably low. The multiplicity of unlubricated small parts and bearings, together with their comparatively great weight, makes it necessary to provide an engine disproportionately large for the useful load. Further, even with a powerful engine, high speeds are impossible. The ideal track must therefore possess high efficiency at moderate speeds, and also be capable of adaptation to high-speed machines moving over rough ground.

The last great defect of the ordinary caterpillar is the awkwardness of the steering arrangements. A track consisting of a great number of linked components can not be deviated for steering. In all ordinary caterpillars steering is effected by a differential gear, one side or the other being partially locked by a brake. The track which runs the faster pivots round the other track, and sideways skidding of the track results. If in order to make a sharp turn one track be completely locked, then the whole machine will pivot round the center of that track, and the length of the track must skid bodily sideways to turn. The ideal track will enable the machine to turn in a reasonably small circle without skidding or awkwardness.

No ideal track has yet been constructed. The experts, however, impressed with the idea that unless some developments in the direction of increased efficiency were forthcoming the caterpillar can have little or no commercial future, have evolved a type of track which seems to promise a great step forward toward the ideal.

Fig. 1 shows the principle of the new suspension. It will be seen that the wheels AA, which run in contact with the flexible track XX, are pivoted in pairs on triangular bogies B. On each bogie are double pulleys C, over which a wire rope DD passes. This wire rope also passes under pulleys EE, attached to the chassis. A second wire rope FF connects together the whole of the bogies B, and the ends of this rope are secured to the vehicle, the rear connection being through a strong spring. It will be seen that each unit, consisting of a bogie and two wheels, can float sideways on the rope, and also vertically. When the track passes over an obstacle the bogie immediately over the obstacle rises against the tension of the rope, the necessary extra rope for the movement being provided by the compensating spring at its end. As the entire weight of the machine is suspended upon this rope in tension, it will be seen that the distribution of pressure is equal over the obstacle and over the rest of the track. It is further obvious that the use of a wire rope obviates the many pins and joints necessary in the usual track; the rope also withstands abrasion by grit much better.

As an illustration of the increase in speed and overall efficiency obtained by means of the new caterpillar, an experimental conversion of one of the tank type of machines may be cited. This machine, which weighed 30 tons, had with the original track a maximum speed of 5 miles per hour. After the necessary conversions to the track, suspension and gears the speed was increased to 15 miles per hour on the level, and 25 miles per hour on a slight down gradient.



Another interesting experimental type of crawling drive

Several experimental types of vehicles have been fitted with the improved track. We illustrate an ordinary chassis converted to the caterpillar type. The track, it will be observed, consists of a stout rubber-covered belt running over large pulleys front and rear, these being the original wheels of the car slightly modified. The way in which the individual elements of the suspension adjust themselves to local obstacles is well shown, and the principle of the suspension is made very clear. The friction-driven rubber belt is very light, and permits the attainment of high speeds. This model has exceeded 30 miles per hour over rough fields. At this speed the shock due to obstacles was completely absorbed by the suspension, and no perceptible jar was transmitted to the passengers. Another interesting experimental vehicle is that where a similar flexible rubber track is applied to a motor scooter. The frame

and engine of this are converted from a motor bicycle. With the engine shown, a small 350-c.c. horizontally-opposed twin, this vehicle can maintain 20 miles per hour over rough ground with no discomfort to the rider. It will be noticed in the case both of the car and the scooter that steering is provided for by the lateral play which the flexible rope suspension permits. The scooter is capable of turning, by deflection of the track, in a circle 5 feet in diameter. It must be understood that these models employing the flexible rubber track are not designed for commercial operation. This type of track, although admirably suited to experimental work, is by no means ideal, and the types shown must be regarded strictly as experimental. None the less it would seem as if with the light pressure obtainable by the use of this track and the absence of skidding in steering, these tracks might be developed for use by commercial vehicles where comparatively high speeds over rough country are called for.

An application of the new system to a more conventional design is shown. Here the track is composed of metal plates jointed for experimental purposes in four different ways. The lower front part of the near track in the illustration will be seen to be jointed by flexible ropes between the plates; the upper and rear portion being connected by special link pins, which are protected and lubricated by leather sleeves holding grease sufficient for many hundred miles running. The rear track is composed half of special ball type connections, giving large bearing areas, and half of ordinary chain connectors. No special provision has been made in this machine for steering by deflection of the track, but it can steer in a fairly wide circle by reason of the lateral play afforded by the rope suspension. The model illustrated is carrying a heavy load of army bridge-pontoons, but the distributed load does not anywhere exceed 2 pounds per square inch.

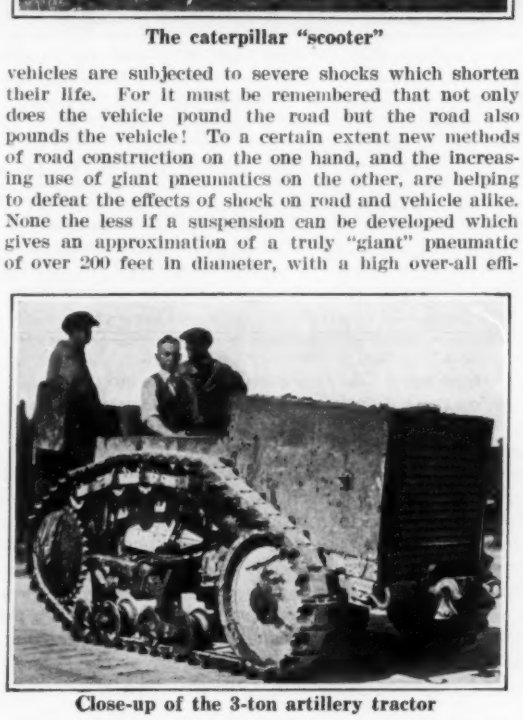
The illustrations show types which are admittedly experimental only, but if these early experiments bear out their promise of closely approaching the ideal they will revolutionize caterpillar design, which is at present stagnant. It is admitted that in undeveloped or partially developed countries there are many transport difficulties which a cheap, rapid and practical caterpillar vehicle would solve. In many instances land lying a few miles inland is inaccessible solely by reason of transport difficulties. Such land is not developed until a railway is built, and a railway will not pay until the land is developed. The ultimate fate of such land is that in the past it has never been developed. A form of tractor enabling sandy deserts, swamps and even steeply-banked rivers to be successfully negotiated at comparatively high speed will aid immensely in the development of such territories.

Constructional work in rough country is always impeded by the difficulty of access. Even where power excavators have been used to clear the way for railways, etc., in many instances the ground has not proved satisfactory for these. The caterpillar track has certainly been adapted for use by the constructional engineer, and excavators, cranes, etc., have been fitted. But the high maintenance costs, the low over-all efficiency, and the low speed have all militated against their extensive use. The recent developments described in this article seem to open up a new field in constructional engineering.

It is not only over rough or difficult ground that the new suspension system promises to make good. The conditions of modern road transport call for high speed combined with heavy loads. The consequence is that the roads are pounded into transverse waves, and that

The caterpillar "scooter"

vehicles are subjected to severe shocks which shorten their life. For it must be remembered that not only does the vehicle pound the road but the road also pounds the vehicle! To a certain extent new methods of road construction on the one hand, and the increasing use of giant pneumatics on the other, are helping to defeat the effects of shock on road and vehicle alike. None the less if a suspension can be developed which gives an approximation of a truly "giant" pneumatic of over 200 feet in diameter, with a high over-all efficiency, then we may expect to see caterpillar tractors in use not only for rough country and soft ground, but at high speeds on ordinary roads. The caterpillar is as yet in its infancy.



Close-up of the 3-ton artillery tractor

Electric Burglary Alarms

THESE were hardly known a few years back, but today there are a great many of the most varied kinds in use. Generally they are designed so as to sound the alarm as soon as a door or window is moved or receives a shock. Movements of the whole building such as are caused by the passing of a heavy vehicle in the street must, of course, not set the alarm going. A suitable device should be constructed so as to sound the alarm also when it is being switched off and when the wires are being bridged over or cut. In one burglary alarm a small ball is caused to drop into a bearing and complete the circuit at the slightest movement or shock, setting a buzzing alarm going. Another device consists of a hollow and hinged arm that is put across the door to be guarded of a night and put back during the day. From the arm a small peg projects that may slightly touch the door of, for instance, a safe. In the hollow arm there are two balanced levers to which the shock or movement is transmitted and these set the alarm going. The apparatus of another company is constructed so as to notify the police at once automatically over the telephone as soon as a stranger enters the closed house or flat. Sometimes it is not sufficient to guard just a door. There may be danger of burglars entering through the ceiling or walls. For such cases a so-called listening plant is installed, which consists of a number of microphones that are fixed in various parts of the premises.

Caterpillar Ordnance

THE United States Army is working toward the elimination of the horse and as a consequence three new types of motor equipment have recently appeared, sponsored by the Ordnance Department. These are a three-ton artillery tractor of unusual ability, a tractor mounting a 75-millimeter gun, and an eight-wheeled tractor carrying a 155-millimeter gun. At the present time only the 75-millimeter vehicle is waterproof, so that it can ford streams, but later on it is intended that all machines shall have this ability.

The three-ton artillery tractor was designed to take the place of the six-horse artillery team for hauling light artillery at speeds corresponding to the gallop of a horse. It has an unusual spring suspension and is particularly well adapted to ride through sand, marsh and rough country without slackening speed.

The creeper belts are so sprung that they will follow the contour of uneven ground in much the same fashion that a snake does it. The lower side of the belt is forced into contact with the ground through the agency of four rollers, each pair of which are connected to one end of a cantilever spring. These springs are pivoted to the frame. Their other ends are linked to four rollers bearing against the upper side of the belt. This construction causes the lower side of the belt to follow the contour of the ground and at the same time keeps the belt taut regardless of the contour. It is interesting to compare this with the rope suspension described above by Mr. Rowlinson for gaining the same end.

The problem of building a satisfactory self-propelled gun mount seems to have been pretty well solved by the type illustrated, which was developed by the Ordnance Department. One of the most serious difficulties has been that of keeping the weight down to a point where road bridges would carry the load. Another is the problem of wheel drive for roads and creeper drive for cross-country. Considering that the gun has a bore of somewhat more than five inches it is remarkable that the total weight of the vehicle is only 22 tons, the gun itself 6 tons.

It is propelled by a 120-horsepower six-cylinder engine, driving through a four-speed gearset. Wheels are driven through internal gears. When the track is removed the middle wheels are drawn up out of the way by a hand crank arrangement.

Left: Eight-wheeled caterpillar mount carrying 155-millimeter gun. *Right:* The 3-ton artillery tractor in action

The sort of service that is demanded of crawling gun mounts and gun tractors

Duraluminum

The Properties and Commercial Possibilities of This New Alloy

By William B. Stout

A MATERIAL one-third the weight of cold-rolled steel yet with the same approximate strength characteristics; a metal which can be heat-treated to higher physical properties, yet by a process which does not take effect for an hour after treatment; a possibility for much lighter and at the same time cheaper production in certain lines of manufacture; here in a few words we have a picture of the possibilities of the new copper-aluminum alloy known as "duralumin."

Receiving its first impetus in the development of aircraft abroad, and particularly by the Zeppelin firm, this metal has been perfected in this country to a point far ahead of the German product, while the work in connection with aircraft of both the airship or lighter-than-air type, and the airplane or heavier-than-air machine, has developed processes and methods now applicable to new lines of production.

The new alloy can be rolled into sheets or forged by hand press or power hammer. It can be cast, welded and soldered, while rivets of the same material used with it show new production possibilities on account of the peculiarity of the heat-treat resultants. Connecting rods have been made of it, using the metal itself for wearing surface without anti-friction metal. These have operated successfully in both motor cars and aircraft engines. Worm gears have been successfully used in heavy truck service against steel pinions. Timing gears of this metal show new possibilities of both wear and quietness, but the most use has been in structural shapes for ultra-light constructions. The metal costs about five times as much as cold-rolled steel, but one-third the quantity is used for the same strength result, while the material being much easier to work than steel in most of its forms saves materially on labor, tool cost and tool depreciation, and on enough production items so that in many cases constructions can be made more cheaply of duralumin than of steel.

The work we have been following has been entirely along the line of minimum weight structures of fairly large size for aircraft work. The saving of a pound in an airplane structure means the addition of a pound of fuel in flight or a pound of pay load, so that in aircraft more than anywhere else minimum weight is a vital item. Strength is, however, no less fundamental, as an airplane in flight at speed is subject to stresses far greater than those imposed on an automobile on the road or any form of present transport. Imagine having to build a motor truck of two-ton capacity that could run across a plowed field at 70 miles an hour without breaking up. This alone would be some engineering problem, yet some modern planes of the bomb-carrying type are designed to do, and do do, this.

Structures are now being built of duralumin which far exceed former strength figures in wood and yet which are lighter than any previous wood-and-cloth airplane constructions. We have at present in process machines capable of carrying twenty passengers at two miles a minute for five hours, and fitted with 600-horsepower engines, yet the whole machine weighs but the same as a moderately heavy touring car. The entire secret of the weight result is, of course, not all in metal, but it is safe to state that the light weight figure could not have been reached with our present knowledge with any other known material.

Many have preferred steel in their experimental aircraft work on the basis that steel in tensile strength was stronger than duralumin even weight for weight. This is so, but the problem of strength in a structure is not ordinarily of tensile possibilities but of column or compressive strength.

For the same weight, duralumin has about three times the thickness of even its cold-rolled boiler plate counterpart, and five or six times the section of alloy steels of high tensile strength. The rigidity of a sheet is dependent on its thickness very largely, and while duraluminum is a much more flexible material than steel in equal sections, yet with the greatly increased sections used for equal strength a much greater rigidity is obtained than with steel.

For example, we have produced a rolled section, designed for a maximum column strength, and yet of such shape as to fit production requirements. This section of .035 thickness of metal in a 19-inch column length weighs 7½ ounces and will support as a column 4 tons, plus. If made of steel of high alloy, its thickness would be, so far as tensile requirements go, about .009, a too great fragility to be trustworthy in a structure on account of the lack of rigidity of such a thin wall.

Duralumin, as we see it, looks very like aluminum, except that it takes a high polish, and that when polished the glinting red of the copper in the alloy can be detected. The polish in ordinary atmospheres is permanent, the metal being non-corrosive to a high degree. In the tempered state it is almost impervious to salt spray, though in the annealed form salt water affects it.

The chief difference between this and previous aluminum alloys is its property of having its physical characteristics materially changed by proper heat-treatment. This heat-treatment in itself acts differently than with other metals, leading to some peculiar production possibilities.

Like all new things, this metal with its peculiar properties has certain assets and definite liabilities, but even its liabilities, in some cases, can be termed a profit, provided the structures made of the metal are designed to fit the peculiar requirements of the alloy.

The most marked difference in the metal is that the change in physical properties following heat-treatment is not instantaneous, but very gradually arises to a maximum after about four days; and during this period not only is the tensile strength increased as high as 50 per cent or more, but the elongation increases from 600 to 800 per cent. More than this, the metal in its heat-treated form can be reheated and softened for passing through mechanical processes of not too violent a nature, and at the end of one hour come back to its original tempered characteristics. The fact that the extreme properties of the metal are not reached immediately, as in most metals, is of great advantage commercially, as it will be explained later.

The heat-treatment of the metal, or tempering, as it might be called, consists of heating the metal to 920–940 degrees Fahrenheit for from 7 to 30 minutes, the time being governed by the amount of metal in process. The material is then quenched in boiling water. It is then removed from the quenching bath and worked upon as soon as possible. In from one to two hours' time enough hardening will have taken place so that it will be difficult to work the metal. Where the time involved in making up the piece does not exceed one hour and where the bendings or hammerings are not too severe, this process is in every respect a thoroughly feasible production method.

This allows us in our airplane work, for example, to heat-treat a coil of sheet metal in a bath of sodium and potassium nitrates, quenching in an adjacent tank of boiling water and uncoiling the sheet or strip, start it immediately through the rolls which form it into the shape desired, having our complete process over and the spar ready for aging within 20 minutes from the beginning of the operation.

It is not my intention to go into any of the technical details or metallurgical study of the scientific side of this new alloy, but rather to point out the numerous possibilities opened up by its use and to describe and explain some of the results and processes now being obtained with duralumin, primarily in aircraft work. I will only state that the metal itself is nothing other than a copper-aluminum alloy, the copper running about 4 per cent, and some magnesium, but with zinc as the most detrimental component. For this reason, duralumin is made only from the purest 99 per cent aluminum, so that the impurities in each of the alloys from which the metal is formed will not build up a detrimental quantity. It is the inability of the Germans to obtain pure aluminum which has hindered their duralumin alloy from equaling the figures obtained in every-day production from the American product.

In the early metal, considerable trouble was had with corrosion and with sheets, seemingly without reason, granulated; and until the properties and difficulties were worked out, structures built of the material were more or less uncertain and required frequent inspection. This is still true in very thin gages which are not very carefully heat-treated, but with pieces of any real section, corrosion is now an almost unheard-of thing.

The main trouble had with duralumin is more or less similar to the problem met in other alloys; that is, the presence of impurities in the ingot, or air bubbles, small in their original forms, but which, when worked out and forged into thinner sections, developed into serious defects.

Most of our material is of .035 stock, so that a very small speck of dirt can make a serious flaw in the metal sheet and a very small air bubble can make a considerable pipe in the center of the sheet, almost impossible to find except by microscopic examination, added to considerable good luck.

Most of these flaws do not show up until after the rolling. In this case the greatest stress on the metal in putting it through the rolls is at a hidden point, so that to inspect these spars or chord members a dental mirror is used with a high light, and the surface very carefully examined. Frequently a hole as small as the point of a fine needle can be opened up into a flaw five inches long—a sort of stratification of the metal resulting from original ingot impurities.

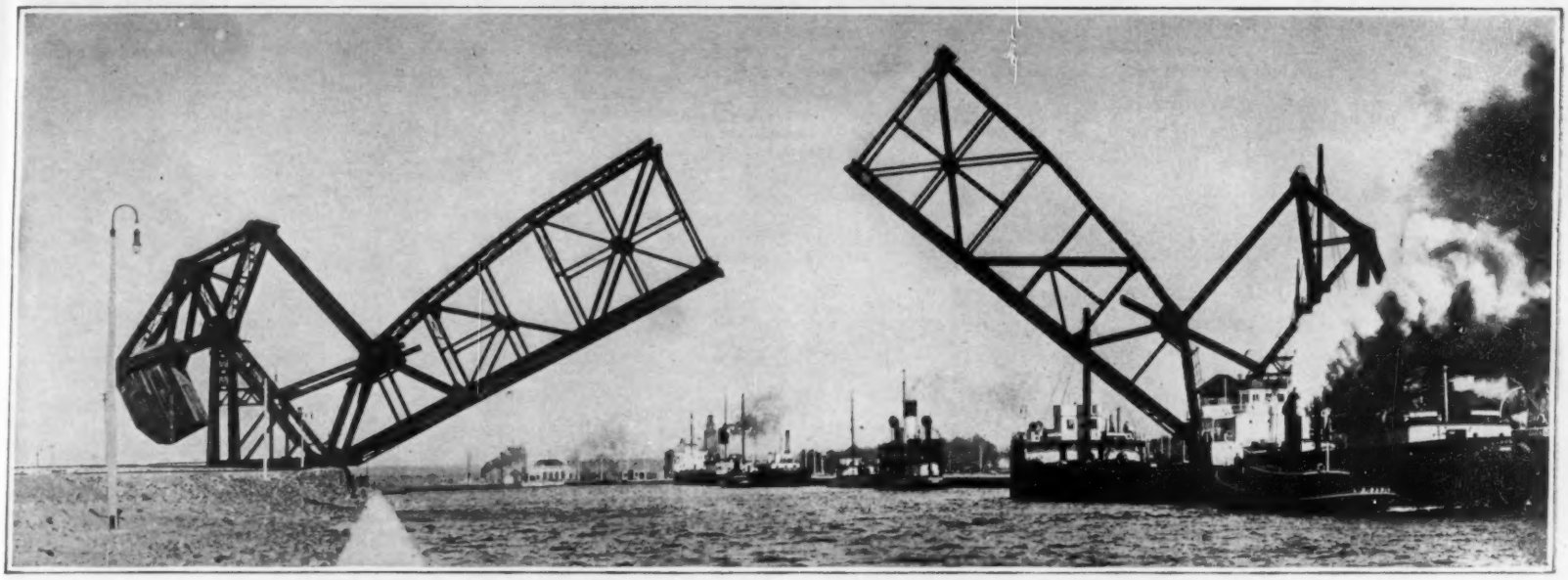
At the beginning of our work, spar rejections, for this reason, ran as high as 400 per cent of the accepted pieces. This was gradually reduced, and it seems possible in the near future that our rejections will be normal. In all these sections there has been no attempt at drawing the metal, but merely bending it, as any attempt to draw the metal results in an extreme number of rejections through cracking. It is peculiar that these cracks may not appear until a number of hours after the piece is made, so that after rolling four days is allowed to elapse before parts can be inspected for cracks or flaws and before use.

The great drawback of the material as we are using it at present is the presence of ingot flaws, rolled out in the sheet, which lead to a very high rejection cost. When this is cured, we can say, I believe, that the experimental stage of duralumin is over. As soon as quantities of the material are demanded also rolls can be put in for greater widths of sheet than at present available—sixteen inches being now the best obtainable—and tubing and other structural forms can be made available.

I believe that this material, and developments from it in better alloys, will eventually be more universally used than steel for structural requirements. Its use in aeronautics is already definitely established, new as it is, and the all-metal plane already given preference to the older types. I believe we will next see it in motor cars, at a saving of over half the weight, and in boats and buses, street and railway cars, bridges and girders. For the time being, however, it is a material to watch and sutdy, and to make use of conservatively. I append a table of its physical properties.

Specific gravity	2.80
Weight .102 lbs. per cu. in.	
Melting range, Centigrade	540 to 650
Compressive strength tempered	44,000
Shear value tempered	30,000
Tensile strength tempered	50–60,000
Per cent elongation tempered	16 to 20
Modulus elasticity	10,600,000
Coef. expansion	.00000226 per ° C.
Yield Pt.	30,000

THE mere word "duraluminum" is by no means a new one. All of us recognize it as the name of one of the newer alloys. The very fact that there is such a vast number of these, however, is apt to close our eyes to the importance of any one of them. We are very apt to let ourselves be ruled by the impression that there is a new alloy every day, and that there is not much that we can say about any of them to make it stand out above the rest of them. The real facts are, that some few of the metals put on the market within the past five years are of such character as to have made themselves already of fundamental importance in modern technology. Of these newcomers by no means the least dominant is duraluminum; and we are very well pleased to have this account of it from one of those instrumental in its development. The text here given is adapted from an address by Mr. Stout before the American Society for Steel Treating.—THE EDITOR.



Bascule Bridge across the St. Mary's River, in the raised or open position to allow passage of shipping

Failure of St. Mary's Bascule Bridge

How a Girder in the Counterweight Truss Gave Way and Stopped the Bridge Traffic

By August Kuhlmann

RECENTLY a member in the counterweight truss of the large railroad bascule bridge across the St. Mary's River gave way and all traffic across the bridge was stopped. The break took place in the member BF only a short distance from point C at D, as shown in the diagram below.

The failure came about in the following manner: At a change of shifts the bridge was open, and on starting to close it the operator heard pieces of cement falling. Stopping the closing operation, he went out to investigate and found a one-half-inch crack in the concrete. The operator, after notifying his superior of the break, received orders to lower the bridge to let a train pass. Finding the crack opened up more the bridge was again opened. While again inspecting the crack with the bridge completely open the steel members were heard to snap and one after the other of the plates and angles making up the broken member gave way.

The girder is made up of four 4-inch by 4-inch by ¾-inch angles riveted to two 28-inch by ½-inch plates separated by ½-inch webb and lattice members, as shown in the illustrations. The member CF, which is 23 feet long, has an area of 70 square inches and a calculated unit stress of 16,000 pounds per square inch under tension.

In breaking, the member CF not only pulled apart but also moved out of line, as shown in the illustrations, point D being higher than C. In addition the counterweight G swung over so that it was binding on the column on the opposite side, corresponding to BN. This caused the members on the opposite side corresponding to EF and BF to be bent out of line by at least four inches at the lower extremity, straining them considerably. It was feared that they also might break. In order to make repairs to the broken member it was necessary to get the member BF in line again. The plan decided upon was to lift the low edge of the counterweight, so that it would not bind against the column, and then lower the bridge, supporting the greater part of the weight of the counterweight on jacks, so that the weight of the counterweight itself would force the broken member into line and also close the break.

Heavy timbers and jacks were therefore placed against the NM face of the counterweight; but it was found that instead of lifting the counterweight to any extent it just pushed it in toward the left. Jacks were therefore also placed against the G face and at the corner, to prevent this horizontal motion backward. The jacks were not powerful enough for the work and operations were halted until ten 100-ton and fourteen 50-ton jacks were secured. With these the counterweight was righted.

The electric drive for operating the bridge, which applies power to the rack H through the pinion P, could not be used, as the counterweight truss would be strained too much and at best the speed of lowering would have been too fast and jerky, and it was necessary to avoid strain as much as possible. The bridge was lowered by exerting pressure with the jacks on the MN face of the counterweight, until the jacks began to tip slightly, and operating the pinion P by means of hand gearing, blocking the counterweight in position, getting a new hold with the jacks, and repeating the operation. As the bridge was lowered the jacks followed up the counterweight and had to be continuously moved up and out. As a precautionary measure in case the pressure on the counterweight should overbalance the bridge and let it fall, two cables were fastened to the upper end of the leaf and led to winches. No tension was kept on the cables, but it could be applied at any moment. This precaution was found to be unnecessary.

The plate of member CF, which was embedded in the concrete, was found to have elongated considerably, and its length was cut down to an equal amount. The outside plate was not elongated. The outer plate broke in more or less straight line while the plate in the concrete had a ragged break.

As was expected, when the bridge was finally lowered the broken member came into line and the gap was also closed, due to the compression on the member.

When the bridge is closed the member CF is under compression; when open it is under tension. The maximum tensile stress was calculated to be 833,000 pounds and that on compression 1,107,000 pounds, using a 33 per cent impact stress when the bridge is closed. The member was designed for this maximum compressive stress. Several years ago the member BC failed just above C, and this member was reinforced, but the reinforcement did not extend to the present break. Several other bascule bridges have failed in the same place.

Trains were allowed to cross the bridge as soon as the broken leaf was lowered, but as nothing except the compression on the member BF held it in place, the leaf could not be raised, except a slight amount to allow the other leaf to be raised. By operating only the other leaf and using tugs to keep the boats clear of the broken member, neither rail nor water traffic is interrupted.

The broken member has been joined temporarily by riveting angles across the top of the broken angles; also two patches were put on each plate. Two patches were used in place of one in order not to take out any more rivets at one time than necessary in order not to weaken the plate any more than was necessary.

In order to take as much strain as possible off the broken member until permanent repairs are made during the season when navigation is closed, cables were placed around the counterweight as shown in the illustrations. Cables have also been placed around the counterweight on the other leaf to prevent the same accident there.

Permanent repairs will be made to both leaves. The exact nature of these repairs has not been decided on, but probably the whole broken member will be replaced by a stronger one.

Specimens of the steel were taken for examination to determine if the material was at fault. Announcement has not been made of the results of this investigation.

The counterweight, which weighs 2,299,000 pounds, is provided with doors, so that weights may be placed in its hollow center for adjustment. In the summertime the bridge floor dries out, and to maintain the balance extra rails are laid on the floor. In the fall as the floor grows heavier with moisture they are removed.

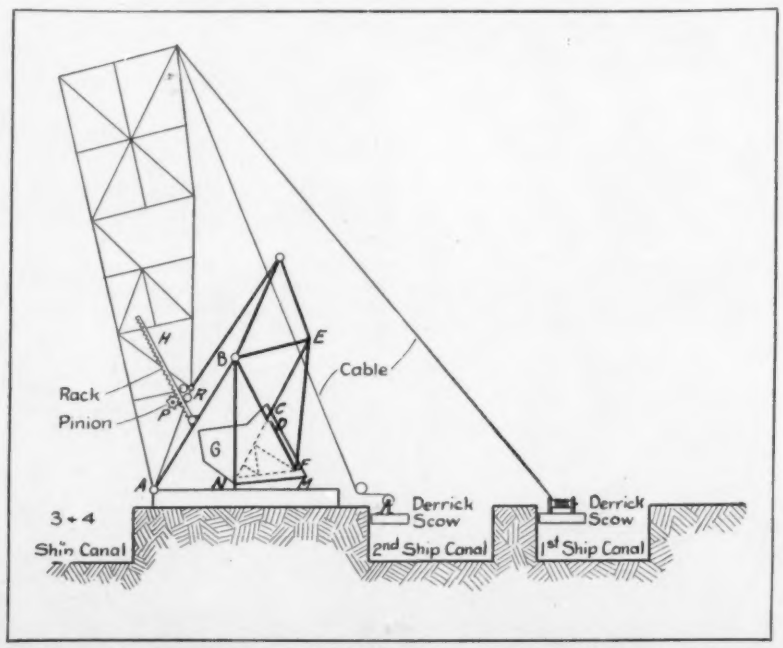


Diagram showing one-half of the bridge open, and the point D at which the steel member CF parted, disabling the bridge

In order to take care of expansion and contraction of the leaf the whole leaf as well as the counterweight truss is on rollers and the leaf can be moved forward or backward by means of hydraulic pressure.

The Oppau Disaster: Facts and Conjectures as to Its Cause

By Paul J. Mallmann, D.Sc.

ON Wednesday, September 21st, at 7:32 A. M., two successive detonations shook the entire district of Ludwigshaven and Mannheim, in lower Baden. The second was of terrific violence, virtually razing to the ground not alone the major portion of the Badische Anilin und Soda Fabrik chemical works at Oppau, in which it occurred, but devastating the entire village as well. Fortunately the explosions occurred when the men as a whole were not yet in the plant; even so, the final returns showed 426 killed, 160 missing, and no less than 1952 wounded.

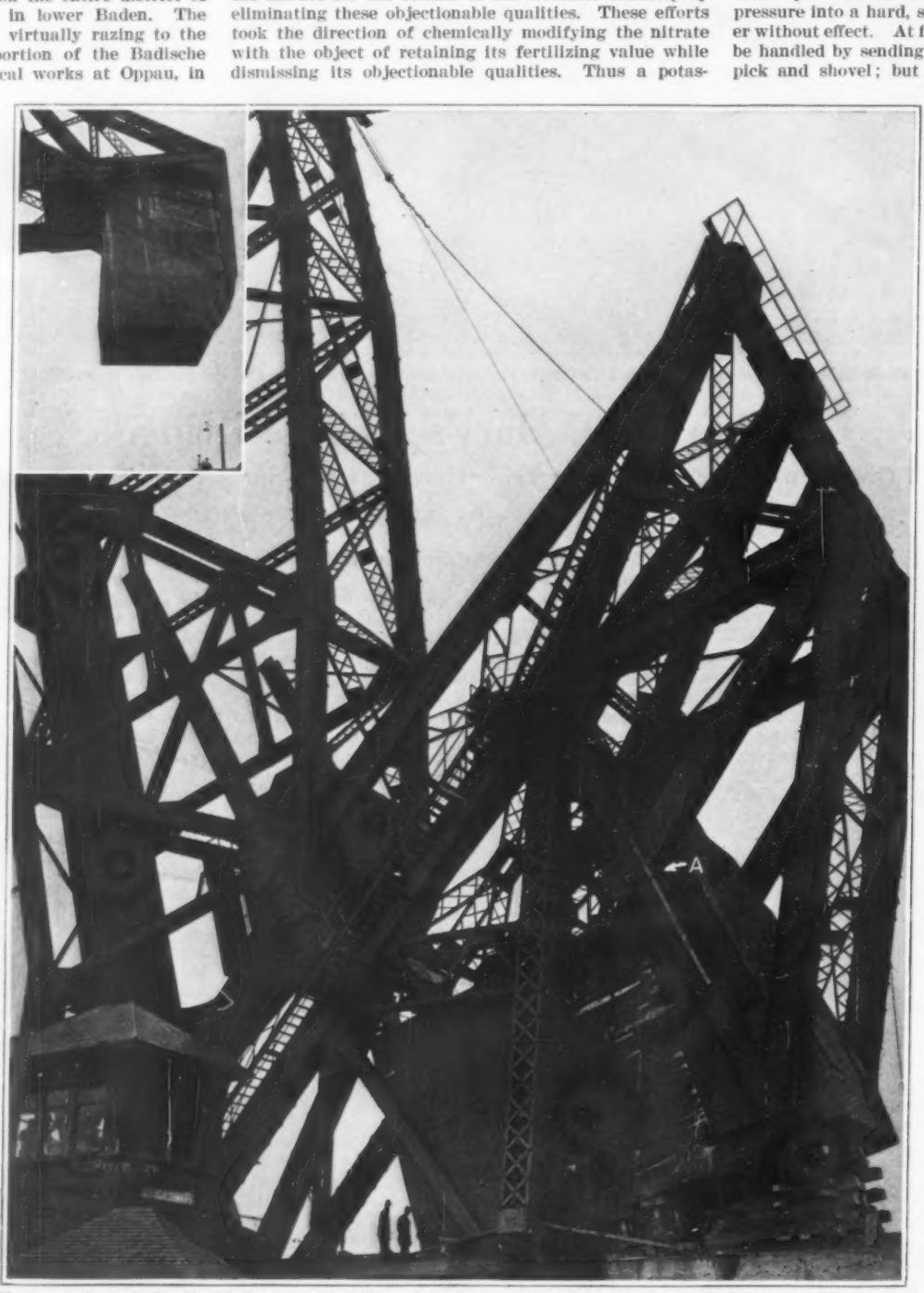
To understand the circumstances leading up to the disaster it is necessary to review shortly the work of the Oppau plant. This is one of the big German centers of fixation of atmospheric nitrogen. During the war the ammonia thus obtained was employed for the production of niter to be employed in the manufacture of munitions. On the conclusion of hostilities the plant was restored to the purpose for which it had been built in 1911-13: the manufacture of fertilizers. Prior to the war the question had arisen as to the form in which nitrogen salts might best be put on the market for this use. The German farmer has become rather accustomed to the use of ammonium sulfate; and it appeared a simple problem to the Badische company to exploit their Haber-Bosch process, by which the atmospheric nitrogen is converted into ammonia gas, by passing this gas through sulfuric acid and producing ammonium sulfate in competition with the gas works and the by-product coke-oven.

Unfortunately, as the author has shown ("The Recovery of Sulfur from Blast-Furnace Slag," SCIENTIFIC AMERICAN MONTHLY, October, 1921), Germany imported annually prior to 1914 some 1,250,000 tons of iron pyrites, sulfur blends, and other raw materials used in the production of the universal acid. This supply was cut off by England during the war, and afterward such circumstances as the low value of the mark, the high cost of transportation, and the exorbitant price of the commodity as such, made it out of the question to return to the importing of the pyrites. To avoid the consequent heavy increase in the price of sulfuric acid the Badische plant has developed an alternative process for the production of ammonium sulfate which does not require the acid at all, but makes use instead of the calcium sulfate, or gypsum, which is present in Germany in inexhaustible quantities. By a simple chemical process the calcium is displaced by the ammonia, and the desired product obtained.

Another nitrate fertilizer of established reputation is ammonium nitrate. Just as the sulfate is obtained by passing ammonia gas through sulfuric acid, so this is made by passing the gas through nitric acid. It is, speaking strictly from the chemical viewpoint, a more advantageous foodstuff for plant life than the sulfate or chloride of ammonia, and it is necessary for a plant like that at Oppau to give attention to its manufacture. But ammonium nitrate possesses properties which do not permit its use without further precaution. It can not be stored because it "deliquesces"—*i.e.*, it absorbs water from the air until it dissolves into a liquid form; and under certain conditions likely to arise in its use, it develops pronounced explosive qualities.

During the war, when everything connected with sulfur was so valuable, efforts were made to substitute the nitrate for the sulfate in the fertilizer industry by eliminating these objectionable qualities. These efforts took the direction of chemically modifying the nitrate with the object of retaining its fertilizing value while dismissing its objectionable qualities. Thus a potassium-ammonium nitrate was obtained which served very well, except for the fact that the potassium itself is an active fertilizer, and one which the farmer might well object to paying for when he did not need it. A calcium-ammonium nitrate did not give satisfaction in use. Finally, with the coming of more nearly normal times, it became possible to use sulfates once more as fertilizer; and the problem of the utilization of ammonium nitrate was met by the combination of the nitrate and the sulfate into a nitro-ammonium sulfate.

All fertilizers must be manufactured throughout the year for obvious reasons of industrial economics; but the farmer has a firmly rooted habit of buying them only during the few weeks when he is about to use them. This means that the factory must store vast quantities of the material. The Oppau plant met this condition by the use of large, well-constructed silos, where the nitro-ammonium sulfate described, which had become definitely one of their major products, was accumulated against the coming of the buying season. These silos were originally equipped with large dredgers for the loading and unloading of their contents. But during the months that elapsed between storing and removal, the salt, heaped up to heights of 45 and even 60 feet, developed great pressure. The lower portions of the mass were compacted by this pressure into a hard, stony mass which turns the dredger without effect. At first it was supposed that this could be handled by sending workmen in to break it up with pick and shovel; but it was quickly learned that the mass was not solid, and that the cave-ins caused by the empty spaces were a source of injury to the laborers.



Close-up view of the disabled counterweight and its frame, weighing 2,299,000 pounds, with the bridge in the opened condition. The arrow at A shows the break extending clear through the member, which is 28 inches square at this point. The top left-hand view shows positions of counterweight when bridge is lowered. Note the cable lashings to relieve stress on frame

To meet this situation the management decided to blast the material loose. Powerful explosives were not required, since the cohesion of the salt was not pronounced. It was decided that the safety explosive of the coal mines, which blasts the coal without igniting any of the fire damp in the surrounding atmosphere, could be used with complete propriety. To make the explosion most effective it appears that pneumatically-driven steel tools were used for the drilling of the holes in which it was to be placed. Both drilling and detonating were under the most competent supervision obtainable, as is evidenced by the fact that some 16,000 of these blasts were made without the slightest mishap. The management of the company, in fact, still takes the attitude that the cause of the explosion that ultimately occurred is a mystery. The author ventures the following suggestion, based on his own experience with explosives extending over many years.

It is admitted that ammonium nitrate possesses under certain conditions explosive properties. It does not necessarily follow that an admixture of the sulfate with the nitrate in the presence of water will eliminate this tendency. All that is necessary is to create the conditions required, and we shall have explosion. These conditions are: heat, pressure, gas—and then a spark.

The presence of pressure in a mass of more or less continuous material 60 feet high is obvious. That the substances with which we have to do will, under such pressure, produce a certain amount of gas is equally certain. The continued generation of this gas, and its continued confinement, will produce heat. All that is now necessary is the spark. If we do not have a spark, we may very well subject the mass of nitro-ammonium sulfate to 16,000 violent upheavals without any unfortunate consequences. But this does not in the least assure us that, with a slightly different set of conditions, the mass will not explode.

To create the spark necessary to change the situation from one of safety to one of disaster it is at least conceivable that the safety explosive went wrong and did something which it is not supposed to do. Spontaneous combustion of the heated and compressed gases upon the introduction of oxygen through a drill-hole is another possibility. Their ignition by a careless workman's match or cigarette as they escaped from such a hole is still another. The most probable hypothesis, in my mind, however, is that a friction spark was produced by the drill's striking the concrete floor.

Learning While Earning

The Organization, Operation, and Results of an Automobile Factory Trade School

THIS is the story of a trade school which was organized at the Ford Works, Detroit, for the purpose of giving the boys in that institution an opportunity to continue their education, and at the same time to learn a trade that would give them more than an ordinary knowledge when they came to meet the problems of life in the great outside world. The school, which was opened in 1916, is regularly incorporated under the Michigan laws. Commencing with six boys and one instructor, it had developed by the year 1919 into an institution having 18 instructors, over 350 boys and a long waiting list.

Boys in school-shop, working on special machines

When a boy is enrolled he is awarded a scholarship amounting to over $400 annually. For convenience, this is reduced to an hourly rate and is paid twice each month. A boy thus becomes at once self-supporting while attending the school; and this scholarship is increased from time to time, depending upon the progress and effort of the boy, until the maximum of $600 per year is reached. As the scholarships are awarded on the yearly basis, the boys are paid for all holidays and vacations, including the summer vacation.

In order to develop a habit of thrift, one dollar is added to each envelope every payday. This dollar must be deposited in a savings bank and kept there. Each month the bank books are collected for inspection, and so long as the balance shows that the full amount has been saved, the thrift fund is continued. Many of the boys, encouraged by this incentive to save, have added materially to the fund from their scholarship payments.

A board of five directors directs the policy of the school; there is a department which undertakes the personnel work, enrolls the boys, investigates all applications for admission, keeps in touch with their home life, and gives them such advice as they may seek or as may be useful to them in many affairs of their daily life. Occasionally it happens that suitable homes are found for those lads who may be thrown entirely on their own resources.

As soon as a boy is admitted he is given a thorough physical and dental examination. When it is necessary his teeth are repaired and he receives the proper medical attention. He is then assigned to a class according to the work which he has completed in the public school. The boys are divided into three groups, one of which is in the class room and two in the shop. Every week the groups are shifted; the boy who has spent a week in the class room enters the shop for two weeks, and one of the shop boys enters the class for academic work. It should be understood that, from the moment the boy enters the school he is engaged in useful work. Although it is true that the tasks are graduated according to the boys' ability, nothing is given to them for practice merely. Everything the lad makes or works upon is used, unless he spoils it, and he is kept at work on each operation until he has mastered the process.

Expert mechanics, selected for their teaching ability, train and guide the boys; and the results have been so successful that when they have completed the course the young men are capable of taking their places as journeymen in any tool room. Those of the students who develop qualities of leadership are given proportionate responsibilities in both the shop and the class room. The work is so successful and the results are so practical that the graduates of the school are in demand in the various tool rooms of the Ford Motor Company.

Class in mechanical draughting

The class of work covered is equal to that of the public school, eighth grade, except that the work is based on shop and tool-making problems. In the curriculum emphasis is placed on mathematics and mechanical drawing. The factory of the company is used as a laboratory, and groups of boys are frequently taken to various parts of the plant for observation and instruction. Machines and details of operation are studied in detail. It is a noteworthy fact that work completed in the trade school compares very favorably with the work done in the regular tool rooms, both with respect to quality and the time consumed; moreover, comparatively little material is spoiled by the students.

Front facade of the Ford factory trade school

Atomic Structure

IN the August number of the new *Italian International Review of Science*, Dr. E. P. Lewis of the University of California gives the following statement of the picture of atomic structure due to the work of Lorentz, Zeeman, Rutherford, and Bohr: "There is a central nucleus which may be a hydrogen or a helium atom or a combination of these with binding electrons, and with an excess number of positive charges equal to the atomic number as defined by Rutherford and Moseley. Around this nucleus circulate one or more electrons in circular or elliptic orbits, which have radii several thousand times greater than the diameter of the nucleus. These electrons control chemical valency and emit or absorb ordinary light waves as they pass from an outer to an inner orbit or conversely. Very near the nucleus and practically forming a part of it are the orbits of the electrons whose disturbance gives rise to X-rays. It requires great energy, such as that due to cathode rays with great velocities or other X-rays, to displace these electrons. As shown by the work of Rutherford, the nuclei of the heavy radioactive elements disintegrate spontaneously, emitting alpha particles (helium atoms), beta rays (similar to cathode rays) and gamma rays, which are very short X-rays. Rutherford has recently also shown that the energy of an alpha particle from one of the disintegration products of radium is sufficient to disintegrate the atoms of oxygen or nitrogen with which it collides, showing that they, too, are built up of smaller parts, one of these parts being certainly hydrogen, and another probably helium. It is highly probable that all the heavier nuclei are composed of hydrogen and helium units.

"With increasing knowledge of atomic and spectroscopic phenomena the Bohr hypothesis seems to present a more and more satisfactory picture of atomic structure. Yet there are underlying this hypothesis assumptions for which we have no explanation. It is as yet impossible to explain the existence of a finite number of possible orbits in such a simple atom as hydrogen unless we assume, as do some physicists, that Coulomb's law ceases to apply at atomic distances, and is replaced by a law of force periodically varying in sign with the distance. On the other hand, Rutherford's study of the scattering of alpha particles in passing through matter seems to prove that Coulomb's law does hold good at distances less than the radii of the atomic orbits."

The Human Atmosphere

The Visibility of the Human "Aura" Demonstrated to the Layman

By Albert A. Hopkins

OUR earth, as it makes its diurnal revolution, carries with it a thin skin of air which starts becoming rarified when we go up a few thousand feet; at about seven miles above the ground the air stops growing colder, at 20 miles above the earth is the upper limit of twilight, and at 50 miles begins a region where the atmosphere consists chiefly of hydrogen. Few of us realize that we are carrying around with us a somewhat similar atmosphere in which every person is enveloped by a haze invisible under ordinary circumstances, but which can be seen by special scientific means. This mist, the prototype of the nimbus, or halo, shown in old pictures, has for a long time been manifest to certain persons possessing a specially gifted sight, who, in consequence, have received the title "clairvoyants." It is not with these persons or their illegitimate practices that we have to deal. It is a scientific phenomenon with which we are concerned, and which has been carefully tested by real scientists of unblemished reputation.

The writer has recently been enabled, through the courtesy of Mr. J. B. Allison of Englewood, N. J., to make an independent investigation of this curious subject. The unquestionable evidence of Walter J. Kilner, electrical expert of St. Thomas' Hospital, London, as given in his book entitled "The Human Atmosphere," should at once set aside any belief that this is a by-product of occultism or charlatanism. Professor Kilner says, "Although at present it is impossible to say exactly of what the aura consists, yet I feel positive that we are dealing with an ultra-violet phenomenon. Some women have the power of changing the colors of their auras by voluntary effort (no man or boy has as yet been found to possess this faculty), and these hues unquestionably do not belong to the ordinary visible solar spectrum, so we must be encountering a second and higher spectrum having shorter wave lengths. The physical aura exhibits another interesting property inasmuch as it can be influenced by external forces such as electricity and chemical action. Naturally a considerable amount of time and thought has been devoted in trying to discover how dicyanin affects the visual organs, but the explanation remains incomplete."

Photography may in time assist the experimenter, but the results are not satisfactory as yet. The aura must be viewed through a color screen made of an alcoholic solution of dicyanin, a rare coal-tar dye, and in practice two cells are used containing the light filter. The modus operandi is very simple. The observer holds the cell containing the liquid solution of the dye before his eyes while a focusing cloth or other medium cuts out the extraneous light. This treatment seems to acclimate the eye for viewing the aura. Some persons require only a half minute, but the writer found that in his case a minute and a half was necessary. The eye having been charged, as it were, or at least educated, all is now ready for the test. An ordinary closet lined with black textile-like velvet is satisfactory, the black of the closet itself being what is known as "Chevreul's black," according to the classic experiment in which an imp was cut out of a small black box, and the hole appeared much darker than the surrounding box. Light must shine on the subject sufficiently to illuminate it fairly well, and subdued daylight or artificial light may be used.

The hands answer very well for experimental purposes, although the entire body is, of course, more spectacular. The human object, or patient (for this new contribution to science is valuable from a medical point of view), stands at least a foot in front of the background to prevent shadows or marks on it from producing an optical illusion. We are now ready for the demonstration.

The observer will, as a rule, be almost immediately able to detect streaks proceeding from the fingers of the one hand to the fingers of the other, and a haze in the interval between the two hands. Directly he has perceived the haze and streaks, he will probably be able to see a similar, but not quite as plain, mist around the arm if bared. Now and then there is some slight difficulty at the first trial, which can be generally overcome if the other hand is held at right angles, and a short distance from the arm. (See diagram 2.) By this means the aura will be intensified, and when the hand is removed the observer will be able to see it round the bare arm. Needless to say, as the eyes become accustomed to the subdued light the illumination will periodically require alteration.

A large percentage of persons after gazing through the dark dicyanin screen at the light are able to perceive the aura as described above, but a small minority find it impossible to detect it without the aid of the pale dicyanin screen. It stands to reason that when this screen is used the light will have to be increased a trifle.

After the aura around the arm and hand has been satisfactorily inspected the observer may with advantage inspect it through the deep carmine screen. For this purpose it will be necessary to raise the blinds a short distance, until the arm and hand can be seen through the screen to the same degree as before. He will now find that the larger portion of the aura has vanished, while the part that remains encircles the limb closely, being usually from one and a half to three and a half inches in breadth. At a cursory glance the texture of this portion of the aura will appear more opaque, but when examined carefully will be found to be finely striated, looking as if brushed out with a camel's hair brush. At places which vary from minute to minute, the lineation can be more easily distinguished than at others. The striated portion has been named the *inner aura*, and the wide amorphous part, not seen when using the carmine screen, the *outer aura*. At times, but by no means always, a close scrutiny will detect an apparently void space between the body and the inner aura. This area is called the *etheric double*.

It is imperative that the hands and the arms should be viewed exactly as if looking at a picture; there must be no straining of the eyes. The more accurately the observer can focus his eyes upon the plane in which the hands are held, the more easily and plainly will he be able to discern the aura. Straining the eyes is not merely a hindrance, but frequently will entirely prevent the perception of the haze.

Directly the observer feels that he will be able to see the aura fairly easily he may proceed to examine it round a large portion of, or better still, the whole body. For the first trial it is preferable that the subject should be in good health and if possible robust, because the aura always loses in distinctness during illness. It is also useful to remember that the aura varies in clearness from day to day even in rude health.

Schooling the eye with the light filter

The phenomena is observed before a dark space

The glass cell containing the dye "dicyanin"

Investigating the human aura with the aid of a rare dye

While the subject is undressing and getting into position for examination the observer, unless he has previously done so, should look through the dark dicyanin screen at the light for a few seconds. The light must now be regulated by drawing down the blinds, when it will be noticed that the amount needed is much less if the whole body is being inspected than when the hands alone are looked at. Standing with his back to the window, and opposite to the subject (using a pale dicyanin screen if necessary), the observer ought to distinguish immediately, or certainly after a few seconds, a faint mist enveloping the body. This varies even in health, according to age, sex, and individual peculiarities.

The first thing to observe is the texture, whether fine or coarse, as no two persons have identical auras. Note the color, which is generally some shade of blue mixed with a greater or less amount of gray. A great help in determining the color is to get the person to place the hands upon the hips, and at the same time to extend the elbows, when in the space between the trunk and the arms the aura emanating from the body will be reinforced by that proceeding from the arms.

Such are the major facts connected with the human "aura" which Professor Kilner so strikingly describes, and his book goes into the subject in great detail, dealing with the aura of health, the aura of disease, the

(*Continued on page 220*)

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Cider Preservatives

IN these days of prohibition cider must be preserved so as to prevent alcoholic fermentation from setting in. R. D. Scott and E. G. Will, in a communication from the State Department of Health of Ohio, report the results from experiments with the use of various preservatives in fresh and partly fermented cider. Sodium benzoate and salicylic acid were found to be of some value in preserving cider commercially, while 0.2 per cent of salicylic acid or 0.1 per cent of thymol preserved cider effectively for the purpose of court work.

Illinois Potash Shales

IN Illinois there are localities where potash shales occur. Potash shales are generally oil shales which contain a workable amount of potash. The yield of oil from certain of these shales is large enough to render them interesting from a commercial standpoint for that reason alone, but in addition thereto they contain a sufficient proportion of potash to make them of very considerable industrial importance. M. M. Austin and S. W. Parr of the University of Illinois discuss the occurrence, composition and utilization of these shales in an article appearing in the December, 1921, number of the *Journal of Industrial and Engineering Chemistry*. In some places the shales contain as high as 5 per cent of potash, while the average proportion is from 2 to 3 per cent.

The extraction of the potash from the shale by the usual methods of leaching is impractical, because of the high cost and low yield. However, there are certain shale outcroppings near Jonesboro in Union County whose chemical composition is such as to render them available for use in the manufacture of Portland cement. This affords a means of recovering the potash, and it is estimated that by applying the known methods of potash recovery in the course of the cement process a yield of 5.3 pounds of potash per barrel of cement can be obtained.

Potash shales, found in certain parts of southern Illinois, with a content of 5 per cent K_2O, can be used directly as plant food. About 62 per cent of the total potash is present in the form of glauconite, which is soluble in sulfuric acid.

Developing Photographs in the Light

R. E. CROWTHER in *British Photography*, 1921, No. 3166, pages 3-4, discusses a new method of developing photographic negatives without the aid of the dark room. The process is one of desensitivation of ordinary plates and othrochromatic negatives by immersing them for about one minute in a solution of 1 in 2000 of phenosafranine. The developing is then accomplished in the regular manner by holding the immersed plate before a candle or an oil lamp.

Utilization of Wood Waste

THE Institute of Science and Industry of the Commonwealth of Australia has just issued a bulletin (No. 19) written by J. H. Boas, on the commercial utilization of wood waste, accumulated at sawmills, in the field and elsewhere, which it is estimated amounts to about 1,500,000 tons every year in Australia. There is advanced the proposition of erecting wood distillation plants which would take care of the entire Australian demand for charcoal, wood alcohol and acetic acid, which is now being supplied from external sources. Work has been done in New South Wales in connection with wood distillation, the results of which indicated that the yields of acetic acid and methyl alcohol were less than those obtained from European and American hardwoods. Particular attention is paid to the possible utilization of sawdust in the manufacture of industrial alcohol, paper, etc.

Australian Pottery Industry

ATTEMPTS have been made for the past few years to locate a clay in Western Australia suitable for the manufacture of potteries. Such a clay has now been found and a small modern factory has been erected. In addition to ordinary domestic pottery, sanitary ware and other classes of white earthenware will also be produced. (Ind. Abs. Aug. 25, 1921.)

Celluloid Rubber

THE finding of a common solvent for both celluloid and rubber has been a problem of long standing. Dr. Rudolph Ditmar, in *Chemiker Zeitung*, 1921, 819 to 820, and *Gummi Zeitung*, 1921, 30 to 40, volume 36, claims to have solved the problem by the use of the hydrogenated naphthalene product, hexalin. The hydrogenation of naphthalene yields quite a variety of products, such as tetralin, tetralin essence, tetralin extra or dekalin, hexalin, heptalin, etc., all of which are available in large quantities in Germany. About a year ago experiments indicated that these solvents would dissolve readily both vulcanized and crude rubber. Not long afterward an investigation was started which resulted in Dittmar discovering that hexalin will dissolve both rubber and celluloid. This is a momentous technical event, and affords a new field for the application of rubber as well as improving the quality of celluloid products.

The process, as described by Dittmar, appears to be as simple as it is effective. Old moving-picture scrap or celluloid scrap from plants manufacturing articles from celluloid, is mixed in an ordinary mixing machine of the Werner Pfleiderer type with the proper amount of hexalin. A solution of rubber in hexalin is made in another mixing machine; then the two solutions are combined in a third machine. Light-colored plantation crêpe rubber is used. The mixed solution is then spread out on a glass plate and the solvent is allowed to evaporate. A very fine product is thereby obtained. The properties of the rubber celluloid film may be varied at will by changing the proportions of rubber and celluloid in the mixture.

Celluloid rubber can be used wherever celluloid itself is used now. Its applications are therefore very numerous. When finely ground mica is mixed with the product—that is, mica in the colloidal state—then a mass is obtained which possesses excellent electrical insulating properties. By using a large enough quantity of the solvent a very high-grade lacquer, colored black if a dye such as nigrosine is used, is produced, which gives a film which can not be distinguished from that obtained with the famous Japan lacquer.

The handle and the stick parts of umbrellas and canes can be made in one piece by simply coating the end, which is to become the handle, with as many coats of the celluloid rubber lacquer as is required to give the desired effect. The lacquer may be colored to suit the taste. The elasticity with which the rubber endows the mixture is of considerable importance in the manufacture of photographic films, and it is likely that the new material will be of considerable use in that industry. This property and also its resistance to wear and tear in the form of a film will probably be utilized to good advantage in the manufacture of artificial leather. Artificial leather, as it now is made, consists of numerous superimposed films of nitrocellulose mixed with pigment and castor oil on a textile background. It is conceivable that a nitrocellulose of similar nature to that forming the basis of celluloid can be used along with a certain proportion of rubber. This would undoubtedly give films of far greater resistant power to mechanical abrasion and of considerably greater elasticity than the ordinary nitrocellulose film now used.

The use of cellon and rubber instead of celluloid and rubber gives a mixture which in addition to the properties of elasticity, etc., is also non-inflammable to a certain degree. Cellon is the name given to a German variety of celluloid which is non-inflammable; it is probably a cellulose acetate product. This mixture made into the form of a lacquer and admixed with pigments or colloidal aluminum can be used to good advantage in coating balloons and the wings of airplanes. The coating is perfectly impervious to the passage of gases and air. Furthermore, the coating is fireproof, which is of vital importance in both lighter-than-air and heavier-than-air aviation.

Zircon, the Mystery Mineral

AT a certain point on the coast of Florida there is a large body of sand which to the naked eye looks like any other sand that is so common at the seashore. Recently a series of tests which were made with a view to ascertaining the properties of different sands gathered at different points along the seacoast from Maine to Florida, revealed the astonishing fact that a certain sand contained large proportions of both zirconium and titanium. After considerable difficulty the location from which this particular sand came was disclosed. The land was purchased and steps were taken to mine the mineral. A regular city was planned and erected, and today a large up-to-date plant is separating about 500 tons of ore daily.

This deposit is unquestionably the largest deposit of titanium and zirconium minerals found anywhere. The ores are very pure, and as there is no overburden, the mining operations are comparatively simple and easy to carry out. The deposit is said to be many miles in extent and is being worked now on a large scale with a probable doubling of the production within the next few months.

The importance of titanium lies in the fact that the oxide of this metal—that is, titanium dioxide—is a highly prized white pigment rivalling in its effectiveness and advantageous properties lithopone, white lead and zinc white. In fact, the only consideration that has been retarding the more extensive application of titanium white has been the fact that it is more expensive than any of the other white pigments. The Florida deposit of ilmenite, which is a titanate of iron, will undoubtedly result in a diminution in the price of titanium white, and when that takes place titanium paint will forge rapidly to the front as the superior white paint.

Zircon is a wonderful mineral, and its proportion in the Florida deposits is not very much less than that of titanium. It is a silicate of the metal and can be made into remarkable refractories in the form of bricks, crucibles, muffles, cements, etc. It will melt at a temperature of 4000 degrees F., and the most corrosive slag will have no effect on it. It is absolutely unattacked by acids and alkalies, and possesses the wonderful property of neither shrinking nor expanding under terrific heat. Wherever there is need for a material which must withstand excessive temperatures and corrosive actions of all sorts zircon is the material which will give very satisfactory service. Its use has been suggested in making vitrified enamels, electrical porcelains, laboratory apparatus, spark plugs, pyrometer tubes, etc.

United States Patents Nos. 1,370,276 and 1,375,077 cover these applications. For further details see the November issue of *Chemical Age*.

Gold and Silver in Shale

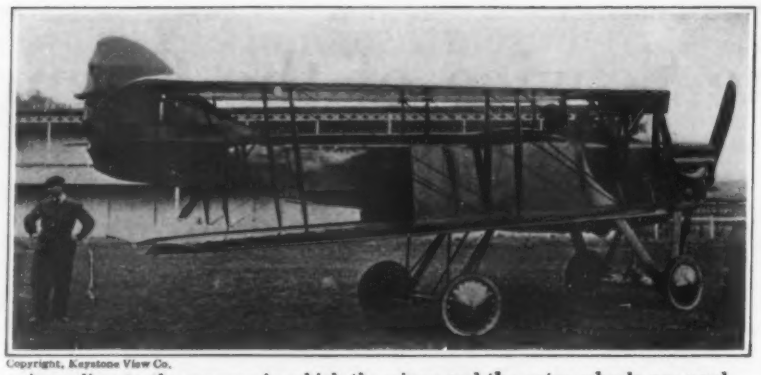
THE association between Colorado and gold and Colorado and shale is well understood, but the idea that gold and silver may be found in shale as well as oil is a new one. The shale is distilled for its oil content, and then the carbonized product is put through the cyanide process for its gold, silver and platinum content. There is a good deal of skepticism being shown as to the practicability of processing the spent shale for the few grains of the precious metals that it may contain. It appears quite certain, however, that colors of gold have been obtained in panning the spent shale. Developments are being awaited with much interest.

Iron Portland Cement

THIS is the name given to a product made from ordinary cement and blast furnace slag, according to the *Chemical Age* of London. The use of slag in cement is, of course, not new, but the interesting point in the article is that the cement is first made in the usual way from lime, silica and alumina, and then it is ground and mixed with not more than 30 per cent of finely pulverized blast furnace slag. Far from being considered as an adulterant of the cement, the slag actually increases the tensile strength of the product, according to practical tests. The reason for this is assigned to the fact that slag contains more silica than the regular cement, and particularly in that the silica is in the form of calcium silicate, which on dehydration is converted into colloidal silica. The efforts of cement manufacturers have been directed along these lines recently, and it appears that in increasing the colloidal silica content of cement the use of slag may be of considerable value.

Auto and Plane in One

FROM France comes the accompanying photograph of the latest novelty in aerial equipment. The Tampier biplane pictured has cleverly adjusted wings that can be folded back against the tail section and out of the way. This done, a second pair of rubber-tired wheels is dropped into place, the motor starts, and we have an attractive automobile. Land traction of this sort by means of an air propeller is not new—indeed we get it in every plane until the speed is reached which carries the machine clear of the ground, while strictly land machines of the sort have been put forward before. This is the nearest approach that we have yet seen, however, to an actual combination of plane and automobile.



Copyright, Keystone View Co.

According to the manner in which the wings and the extra wheels are used, this machine is an airplane or an automobile at the driver's pleasure

The Vacuum-Bottle Milk-Car

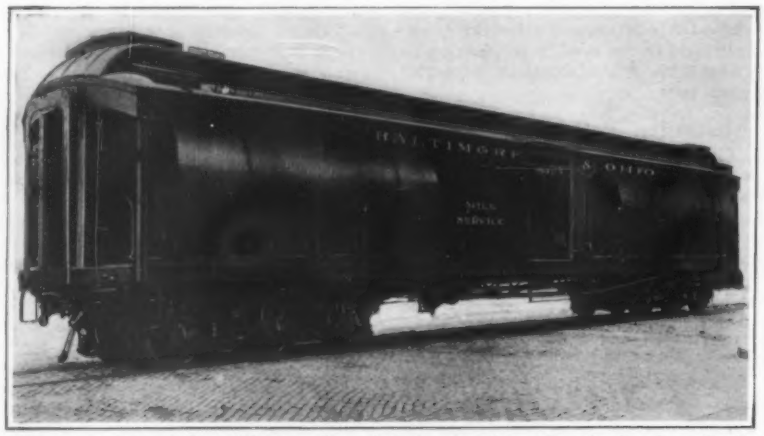
WHEN we go on a picnic, we take cooling liquids along in the vacuum bottle; we would not think of packing them with us in ice. Yet when we come to the more serious business of transporting millions of gallons of milk to the city, we have retained the older and more cumbrous method just as though the vacuum bottle had never been invented.

A Rochester, N. Y., manufacturer of glass-lined steel ware is now offering a piece of equipment which we may well join him in characterizing as a "vacuum-bottle car." Our picture shows the outside, with a phantom view of what it encloses. Externally it is plainly just a milk car. Internally it is in very truth a vacuum bottle—just that and nothing more.

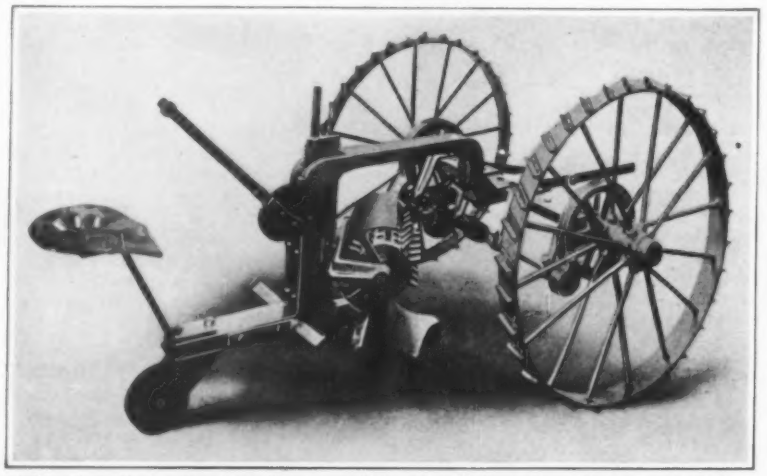
One's first impression would be that the first cost of such an outfit would be at least formidable, and perhaps even prohibitive. But just for the sake of argument, let us compare 100 50-gallon cans, of height four times their diameter, with a single container of the same capacity and the same proportions. We may be surprised, on completing the calculation, to learn that the group of smaller containers will have a surface area, including tops, 4.6 times that of the single large container. We do not have any statement of the capacity of this tank car, but some such comparison as the one cited would hold. Moreover, a truck which is a miniature of the car is used at the loading end, and if necessary at the unloading end, so that the milk goes from the cow to the distributing station with two or at most three breakages of bulk.

So we see that with the consistent use of these tank cars the cost of milk cans would be wholly avoided. The reduction in handling costs is alone such that one creamery was able to dispense with seven out of the eight men formerly thus employed. The cost of cleaning is cut by a larger divisor than the one representing the ratio between the areas to be cleaned, since the size and the character of the inner surface of the tank car makes cleaning far simpler than in the case of the familiar can—indeed, it would be little exaggeration to give this comparison by saying that these factors make real cleaning possible where it has not been possible. Another interesting item is in the waste through clinging of milk to the inner surface of the can. With the old style cans, 150 gallons of the fluid are thus lost out of every 5000 gallons transported; with the single large tank of the car this loss is cut to five gallons in 5000.

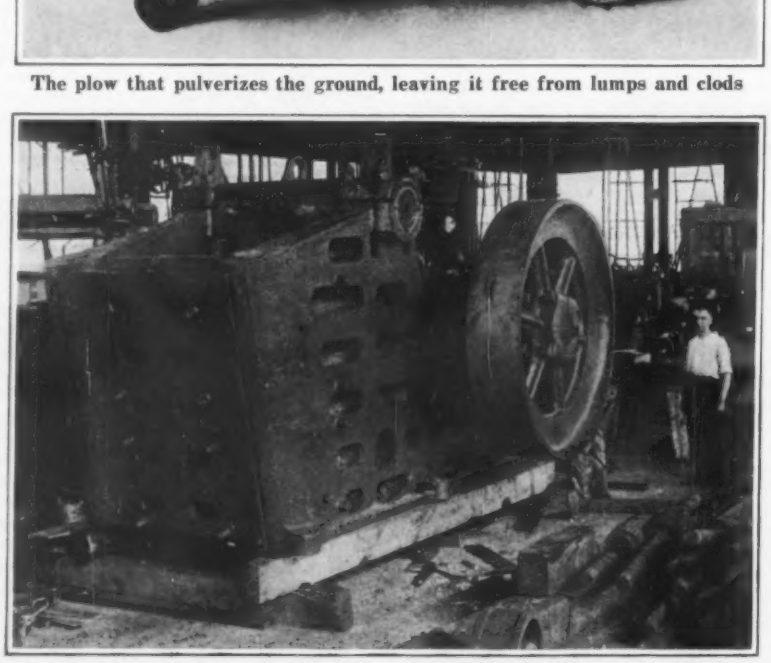
It is pointed out that every dairy which has or can get direct access to the railroad tracks and which gets its milk from constant sources of supply can use these tank cars to advantage. It will be understood that, as is the case with so many other types of special cars for perishable foodstuffs, the shipper rather than the railroad is expected to own the cars, to look after their maintenance, and to operate them when they are not actually on the rails in a train.



Phantom view of the milk car whose interior consists of a single glass-lined steel vacuum tank



The plow that pulverizes the ground, leaving it free from lumps and clods



The absence of corners enables this rock crusher to stand up much better under the severe strains of its heavy work

Recommended Specifications for Tires and Tubes

DURING the war, the Bureau of Standards was called upon by the Motor Transport Corps to prepare specifications for the solid tires used on army motor trucks. The results of this work were so satisfactory that similar specifications were prepared for pneumatic tires and inner tubes. Although prepared originally for the military service, these specifications became standard with a number of other government departments, and the demand for copies of them has been sufficient to warrant the issuing of Circular 115 of the Bureau of Standards on the subject. This may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c per copy.

As the preliminary work in connection with these specifications was carried out with the greatest possible care, and as the Bureau received the cooperation of practically all those interested in the subject, they may be taken as the best all-around specifications existing at present on which to base the purchase of rubber tires. The kinds of tests for tires of various sorts are described in detail as well as the quantity and quality of the materials which they should contain. The specifications for inner tubes are treated in the same thorough manner and the best methods of testing them are described.

The Pulverizing Plow

THERE is no fertility in a sun-baked clod, says the inventor of the combined plow and pulverizer illustrated on this page; and he has accordingly designed his implement with the view that it shall leave no clods to bake. The old method of harrowing and reharrowing the ground is intended to be done away with by this tool. With its use the earth as thrown up by the plow-share is caught by the pulverizing device and made as fine as meal, all in the single operation. The earth thus made and left moist and mellow is better adapted to quick germination of the seed than if prepared after the older and slower method, according to A. P. Merrill, of Natchez, Miss., the inventor.

The Cornerless Rock-Crusher

THE use of jaw crushers of increasingly large size has led to the design of these machines with sectional frames: for the single-piece frame is unwieldy in large models, and its lack of rigidity, particularly at the corners, under the great crushing strains developed in rock-crushing has been a source of trouble. That the construction of the frames in four pieces has not met the latter difficulty is obvious when we find the technical press abounding with accounts of clever methods of effecting emergency repairs in broken jaw-crusher frames. The difficulty is one of faulty design, and should be corrected by the designer rather than by the user.

The corner weakness of the four-piece frame has arisen mainly from the fact that, with the side frames grooved and the end frames mortised into them, bolts have been used to hold these members together. The corner is the weak spot; and in a newly designed crusher it has been in large measure eliminated. The extremities of the side and end frames are made circular in section, the end frames fitting into the side frames and the whole being joined by a heavy steel pin. This results in the crushing strains being balanced throughout the side frames, instead of being localized in the corners. There are no corners or edges, and any slight flexure of the end frames, which formerly produced a crack in the side frame as an immediate consequence, has now no effect whatever on the side frames, since the pin allows the freedom of movement necessary to relieve the situation without transmitting strain or motion to the side frames.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

This socket gives the user a minute to leave, after which it turns off the light

The Delayed-Action Lamp-Switch

A LIGHT that stays lit after you turn it out is one of electricity's most recent developments. The advantages of such a light will be readily apparent to anyone who, in the sudden darkness, has stumbled over a chair en route to bed, or kicked over the waste basket on the way out of a dark office.

The lamp stays on for one minute after the chain is pulled. That brief illumination, however, gives ample opportunity to leave the cellar, to get into bed, to lock the garage or to close the office; in fact, to do any number of things that the darkness makes hazardous.

All this is made possible by an ingenious though simple and rugged thermostatic switch mechanism. The thermostat employed does not itself act as a slowly moving contact to break the circuit, but performs the function of a spring latch, which, when cool, permits the leaf contacts to snap apart.

Heating of the thermostatic latch is accomplished by a small resistance unit which is thrown into circuit by pulling the socket chain, as if to turn out the light. The positiveness of the switch action is such that it can plainly be heard across an ordinary room at the time the light actually is extinguished, 60 seconds later.—*By Fred G. Jopp.*

For more economical use of laundry soap

Aluminum Economies

AN investigation of scrap losses in aluminum-alloy foundry practice showed that the annual losses in the United States amount to $1,200,0000 and that universal adoption of methods recommended by the Bureau of Mines would probably result in a saving of about $600,000 per annum. Melting losses in this industry, which are largely preventable, aggregate about $3,000,000 yearly.

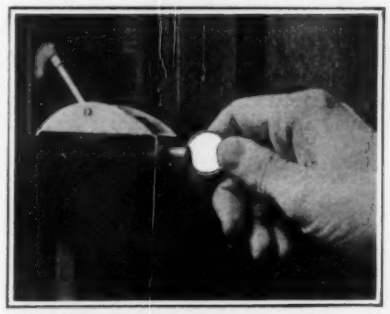
Something New About Inner Tubes

THE inner tube has always been carried heretofore in a flat case made especially for it. Now, they say, on long tours these tubes rub against one another and this exercise is not good for them. This new metal box carries the inner tube slightly inflated, preventing friction when touring. A glance at it will determine whether it is in condition to use, for if there is no inflation something has gone wrong.

A Lock to Carry with You

THIS lock can be used on any window by simply adjusting the screw as shown. It requires no tool, any coin carried in the pocket will do the adjusting.

When it is in place on a window the harder the window is forced from the bottom the tighter the lock is forced against the upper sash. To release, the locking lever is pulled back. It is especially desirable for bedroom windows on the ground floor, as it allows them to be open from top and bottom, yet locked.



This lock locks the window open, and a key is always at hand

It Slices the Soap

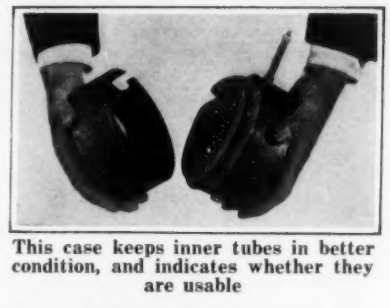
HOUSEKEEPERS will be interested in this invention, which has for its special feature the saving of soap for laundry purposes.

In most washing machines and the common boiler, soap must be cut into small particles. This machine will shave a bar and in doing so will get more soap than by the old hand method. It is not necessary to boil soap for washing, as many people do. It is claimed the boiling destroys the value of its cleansing power.

The cake of soap is inserted, and the handle turned. A guide feeds the soap to the cutter as each shaving is cut off.—*By M. M. Hunting.*

The Lock That Fits Every Door

THE fitting of a lock to a door has always been somewhat of a fussy job. We illustrate herewith a lock fitted with what the makers call an expansion cylinder, which automatically meets the difficulty by adjusting itself instantaneously to a door of any thickness. Instead of actually fixing the lock to the door the set screws of the new lock merely screw down upon two steel claws located on the inside of the plate and facing it. They are screwed down tight, with the effect of jamming these claws into the inner surface of the hole in the door. Provided the hole is of approximately the right diameter, it makes not the slightest difference how thick or how thin the door itself may happen to be. The thickness of the door plays no part at all, the claws gripping the inner cylindrical surface of the hole in a lateral direction. If the hole is lop-sided, even, this can be adjusted by loosening one of the set screws and tightening the other. Another inconvenience that is eliminated by this lock is that of fitting the set screws into the corresponding threaded openings in the cylinder—not an easy task when working in semi-darkness.



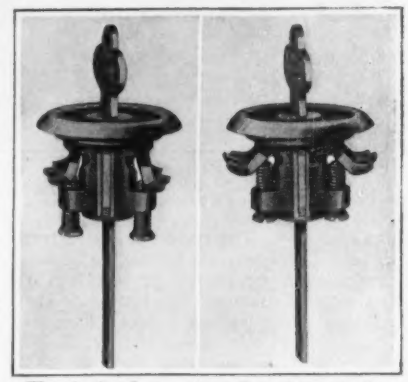
This case keeps inner tubes in better condition, and indicates whether they are usable

Making Palimpsests Give Up Their Secrets

BY a curious trick of fate it seems that in almost every case where a palimpsest is dealt with, the old, effaced manuscript is of far greater interest than the new one. Why it should always have been the case that a Virgil or a Cicero original should have been cleaned off in order to get paper for a personal document of absolutely no significance, instead of the reverse, is a mystery in probabilities, but none the less accords with the facts. Palimpsests are photographed in the ordinary way; with the use of color filters with ultra-violet light; and now a third way of going about the business with the aid of fluorescence is being developed in Germany. Illuminated by ultra-violet radiations of 334 millimicrons from the quartz-mercury lamp, the parchment fluoresces; but the erased writing remains dark. This fluorescent photograph often brings out details not disclosed by other methods, and has much improved the technique of examining old manuscripts.

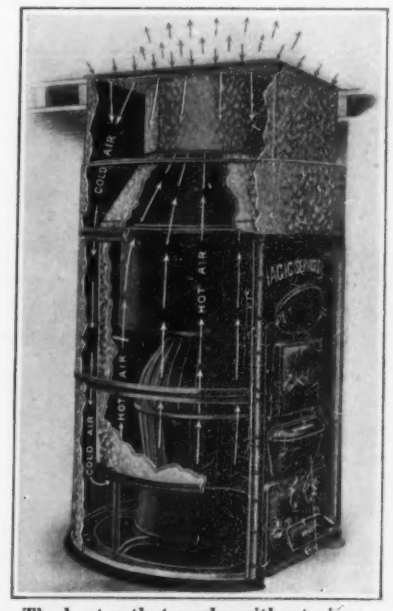
The Pipeless Heater

A HEATER embodying a pipeless system with a series of inner chambers for recirculation of heat, whereby coal is saved and thorough and uniform heat is given, has just been placed on the market. The only pipe connected with this new heater is the smoke pipe.

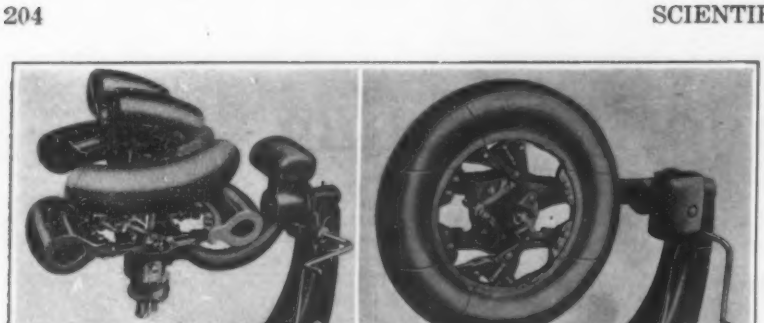


The lock that grips the side of the hole, before (left) and after (right) the set screws have been tightened on the gripping claws

Within the heater there is the usual fire pot. Through the medium of only one register to which the heater extends, every room in the house can be heated thoroughly and uniformly. The register is connected directly with a double chamber of the heater. The inner chamber carries up the heated air, which is automatically distributed throughout the entire house. The outer chamber carries the cold air down to the heater from every room in the home. The heater utilizes the principle of recirculation. As the hot air rises from the heater through the inner circular part of the register, as shown in the accompanying illustration, the cooler air is forced down through the outer part of the register to the heater. The colder air from every part of the house is attracted down through the register to the heating surfaces of the heater, where it is heated and then rises and is diffused throughout all the rooms of the whole house. As the colder air is drawn out of the rooms the warm air is substituted, and this process continues until the temperature is practically equalized through the entire house. There is a slight difference between the temperature at the ceiling and at the floor of each room, which is sufficient to keep the air in constant but gentle circulation in all parts



The heater that works without pipes



The handy tire-building form, shown at the left with all sections folded over, and at the right with all closed

of the house. The recirculation feature of this heater permits the saving of fuel and the proper degree of heat at all times in all rooms. The heater is also adapted for stores, halls, garages, churches and schools.—*By A. H. Kolbe.*

A Job for Faucet-Power

FOR those washing machines that do not empty or fill themselves, this little motor has been designed. It will fill or drain a washing machine or the ordinary laundry tub where water must be carried. The device comes complete with attachments and its inventor claims for it that a stream of water the width of a match will do the necessary work. It takes three minutes' operation of the pump to either fill or drain a tub of water of the ordinary size. The water-faucet motor recently put out by a French inventor was, of course, pitifully inadequate to do all the work that was claimed for it; but the present device should easily be able to set up the preliminary flow necessary to start the siphon action that will speedily empty the tub.

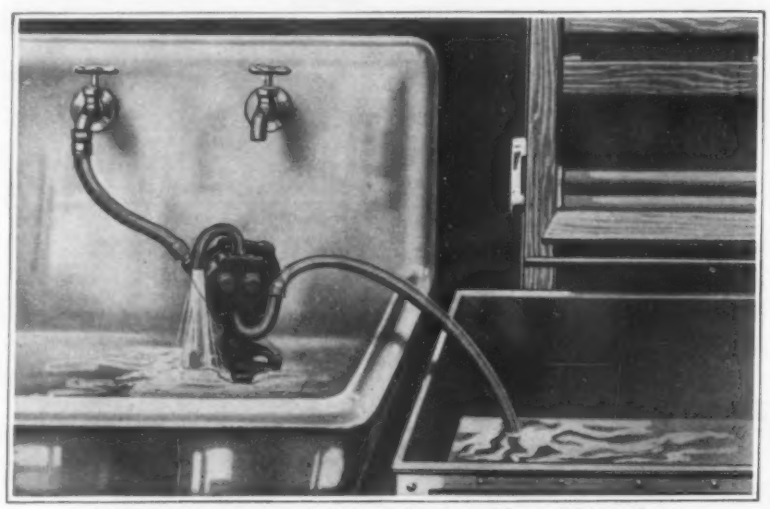
A Sanitary Catch-All for the Kitchen

THIS new sanitary kitchen catch-all is an accessory to good housekeeping that will keep the kitchen and the table refuse out of sight until it eventually finds itself in the incinerator or other means of disposal. A newspaper folded three ways makes a lining for this refuse holder. When ready for emptying, the contents are already wrapped for burning or for the refuse can. The cover fits tightly, keeping all odor within and all flies without. On every ground of cleanliness, convenience and appearance, it is superior to the familiar open bucket or wire sink-basket.

The temporary resting place for kitchen waste, lost alike to sight and to smell

The One-man Tire-Building Form

THE job that usually takes three or four men to remove giant-sized truck tires from a building form can be readily handled by one man with this sectional form. This building form, developed by a New Jersey manufacturer, is made in sections built on three radiating arms. One of these arms is a rack which may be moved by a pinion in the center of the device. When extended the sections fit together to make a form over which the rubber and fabric are placed. All the sections are folded over for removing the tire when the section attached to the rack is withdrawn after manipulating the rack and pinion gear with a socket wrench.—*By Allen P. Child.*



Faucet-motor for emptying wash-tubs without lifting them

Doing Away with the Scissors Grinder

SHARPENING tools, or getting them sharpened, is a great nuisance to the average mortal, and we are led to suspect that one reason for the success of the safety razor is the possibility which it introduces of discarding the old blade in preference to getting it in order again. And just as this is the first real improvement in razors since old King Louis the IXth—or was it the XIth?—felt moved to trust his barber and his doctor alone, of all men, so the corresponding innovation which has just appeared in the scissors may be hailed as the first improvement in this familiar tool since the days when Delilah used it with such effect. The new scissors is built in such a way that the old blade can be removed and a new one substituted by turning a few screws. The body of the two blades is not removable, and does not play any part in the cutting operation. The thin razor-like blade which screws on to the backing provided by the heavier part is the sole business member of the scissors under the new dispensation. The advantage is even more pronounced, we should think, than in the case of the razor; for one can sharpen a razor blade acceptably, if one is put to it, but we have never yet seen a scissors properly sharpened by an amateur.

A Dark Room That Fits in the Coat Pocket

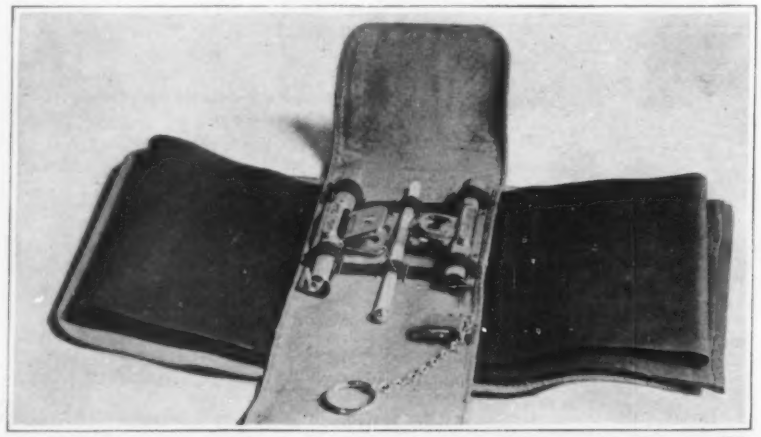
A DECIDED improvement has been scored in daylight developing by the introduction of a new process for which Mr. E. J. Sweetland of Hazleton, Pa., is responsible. Not only does this process eliminate the necessity of the usual dark room with all its paraphernalia and mess, but it has a number of distinct advantages over the usual daylight methods of developing roll film, among them being compactness, extreme portability, neatness, efficiency, and ease of handling.

The basis of this new method is a long rubber bag, which is shown folded in the accompanying photograph of the entire daylight developing kit. This kit and the new method of daylight developing have been invented by Mr. Sweetland. The rubber bag, when unfolded, measures about four feet in length, or sufficiently long to take a full roll of film of post-card size. The first step is to pull out the covering paper of the roll film until the end of the film proper appears. Obviously, the roll film is held tightly in order to exclude all possible light from the film itself. When the end of the film shows, the paper is cut off. On the end of the paper still remaining on the spool is fastened the chain with the ring at one end, while on the end of the film is placed a film clip, of which there are two in the kit. This much accomplished, the spool of film is placed all the way in the rubber bag until the closed end is reached; then, with one hand grasping the film clip through the rubber bag, and the other hand pulling on the ring of the chain and clip, the film is unrolled in the rubber bag and the paper and spool are removed. It is evident that no light can reach the film while it is thus being removed from its paper covering.

The scissors with removable blades that never have to be sharpened

With the film flat in the rubber bag, the next step is to place the remaining film clip at the free end of the bag, which is folded over so as to exclude light, but has remaining still a small free space to permit of introducing and removing liquids. Water is then introduced in the bag in order thoroughly to wet the film. By passing the hand over the rubber bag, which is resting on a table or other flat surface, little ripples or waves cause a constant agitation of the liquid within the bag. The water is then removed, and the developer is introduced. However, since it is impossible to note the progress of development, the so-called factorial system is employed: that is to say, with a known strength of developer, the temperature of same is taken, and according to the temperature a certain length of time will be required for correct development. This method is an absolute one; it makes no difference whether one is watching the process or not. The film might be over or under exposed, true, but that would not help matters any, hence it is best to go by the watch in obtaining proper results.

The developer is caused to flow back and forth by passing the hand over the bag. When the proper length of time has been attained the developer is poured out and water is introduced for rinsing purposes. Then the film, already developed, is removed and placed in a bath of hypo for fixing purposes. This latter operation can be done in broad daylight. The final operation is the thorough rinsing of the film.



This little kit is a complete developing outfit for roll films and makes possible the developing of films anywhere and by anyone

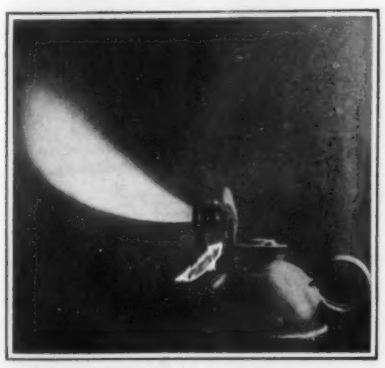
Replacing the time-honored procedure of attaching wax seals by hand

The Electric Sealer

THE royal seal of the most puissant monarch that ever lived used to be attached to the documents of state by means of a lighted taper, which, smoking with acrid pungency, released the heavy drops of wax from the lump held in the hands of the royal secretary. Into the soft mass then the engraved insignia was pressed, and if the worker was quick enough he did a fairly good job despite the very clumsy process. Until recently there was no really great advance over this crude method.

Now, however, the complete job is done electrically. The device is attached to the electric light socket, thus quickly reducing to a molten condition the wax put into the pot. Below this pot there is a cup-like catcher, into which the molten wax flows when released. The insignia to be stamped on the envelope or document is engraved on the base of this cup. When the operator is ready he pushes down on a plunger at the top of the apparatus. This releases the molten wax so that it drops; the stamping face below, which up to this time is turned to one side, then is pointed straight downward, and as the pushing process on the plunger continues the wax is forced through the small openings, and when the plunger is released it will be found that a perfect imprint of the insignia has been made. This process can be repeated about once in five seconds, so that a dozen seals can be attached in a minute.

The photo shows the position of the various parts of the apparatus just before the plunger is pushed down.—*By E. Purdy.*



The blow-torch that needs no pump

A Pitchfork with Removable Tines

AN interesting and useful invention is that of Eric Luukkonen of New York, who has put forward a pitchfork with removable tines. Most of us have seen forks discarded, or used with such ill effect that they might better be discarded, because of missing tines. A fork constructed according to this patent may have all the tines removed and new ones substituted, or where there is but one tine broken this may be replaced. In spite of their removability the tines are held in place so securely that there is no danger of their coming out during use. This invention gives the pitchfork an indefinite life, for the haft, the backbone that holds the tines, and the several tines themselves may all be replaced individually as they give out.

Feather-Weight Opera Glasses

OPERA glasses that require no more attention after once having been adjusted to the eye and the object, and that are so light as to permit their support by the nose in the manner familiar to the wearer of spectacles, are the latest invention of John A. Weis of New York. The glasses are, in fact, made much like the ordinary spectacles, equipped with regular opera glass lenses embedded in a collapsible tube. They may be folded and carried in the pocket. Their weight is but two ounces, so it is plain that they will not become a burden to the nose.

The Self-Lighting Blow-Torch

AN automatic blow-torch has just been put out by a Columbus, Ohio, manufacturer. No pumping is required, hence there are no dry-pump-washer troubles. No blowing is called for. The torch, which will use gasoline, alcohol,

All the sound goes into the transmitter; none is heard in the room

benzine, naphtha, or other volatile fuels, is simply lighted with a match, and in about one minute it commences to operate, and continues until the fuel is exhausted. The lighted match is thrust through the burner coil shown at the mouth of the torch. Inside this coil there is a wick which carries some of the fuel, in liquid form, to the flame. This is ignited, and kept burning partly by its own flame and partly by the match. By the time the match is burned out the burner will be hot enough to generate its own gas. Part of this will then be forced out through the aperture in the vertical section of the coil and the balance will be shunted into the body of the burner. The latter is gas tight, and serves to keep up a constant pressure, forcing the gas out through the aperture in the form of a long, pointed, intensely hot flame.

The Vacuum Brush

WE have had vacuum cleaners for several years past, to chase the dirt out of our houses without creating dangerous dust. Now comes the same principle applied to a brush. The new cleaning apparatus operates exactly like an electric vacuum cleaner; but it weighs less than three pounds, and has a distinctive feature in that it is possible to clean the dust-collecting holder by means of the device itself. A combination dust bag is in the handle of one design, and to clean this bag the end of the holder is removed, the switch turned, and the dust is blown out by means of the motor. For cleaning motor upholstery an auxiliary dust bag is furnished, likewise cleanable by blowing out with the motor.

Opera glasses worn like spectacles, leaving the hands free

The Silent 'Phone

A 'PHONE appliance that can be easily removed from or attached to the instrument, and that is also practically collapsible, completely shuts off the conversation from the hearing of anyone else in the room. The inventor claims for it that it absorbs all sound waves not essential to transmission, and that it provides in sufficient quantity and of clear quality sufficient sound for perfect transmission. In addition to this, outside noises are kept from being transmitted.

The instrument is made of thin metal, six sided, with grooves so that the several parts can be disassembled. The person using the 'phone has his mouth entirely in the good-sized receptacle provided for the purpose. This mouthpiece is of such a curvature that the lips are as close to the transmitter as prescribed by telephone companies. There is a sound-wave absorption unit, renewable and antiseptic, at each end of the device.

It enables executives to carry on a private conversation even in a large office full of other employees, without the nature of his conversation even being suspected. At the same time the voice of the user does not disturb those working around him. The whole device may be sterilized in hot water.

New Automatic Electric Stove

ELECTRICAL stoves, a few years ago alike wasteful of current and unsatisfactory in their results on the food, are gradually coming to a state of development that justifies the expectations of those who believe them the ultimate in kitchen equipment. One of the best designs we have seen is now offered at an unusually low price. It has thermostatic control of a new sort, in which the condition of the food itself plays a part in regulating the switching off and on again of the current. Briefly, when the condition of the oven or pot contents is such that steam is given off to a sufficient amount to be forced out under its own pressure through porcelain tubes in

The vacuum brush that cleans out its own dust bag

the side of the stove, the steam thus escaping heats a thermostat. The latter is of the familiar variety which curves under heating and thereby breaks the circuit over which the heating current flows. Various special vessels, such as triple-nesting pots, are supplied with the stove. It seems to be one of the best electric stoves yet put on the market.

Scientifically Designed Work-Chair

HERE is a chair that has been scientifically constructed to meet the needs of the sitter engaged in a definite task. The purpose of the chair is to enable the woman working in the kitchen to perform her tasks at sink or at table while preparing vegetables, etc., with the minimum amount of fatigue.

Every angle of the human body while so engaged has been figured out for the construction of this chair. If a woman leans back in a chair while engaged in the kind of work mentioned above she will inevitably become exhausted much more quickly than she will if she inclines slightly forward. But this forward inclination also will prove exhausting unless the seat of the chair also tilts slightly forward. For this reason the front legs are made shorter than the rear ones. The seat of the chair is also scooped out just where the weight of the body comes, and this also acts to prevent any slipping forward that might result if the chair were flat-bottomed or if the entire surface were scooped out.

Because it is not essential that the back should be high, and because such a back would be in the way, a low one has been designed.

The chair that meets the worker's needs at every point

Cleaning ball bearings, gears and other small parts in a swift stream of gasoline or oil

How to Clean Shop Work

INSTEAD of cleansing shop work entirely by hand a device like the one illustrated can be utilized for forcing a stream of gasoline or oil upon small objects such as tools, drills, ball or roller bearings, gears or parts of starting motors. Chips, dirt and other foreign matter are washed out and deposited on a wire screen below, the liquid returning to its source to be used again.

A plunger pump operated by hand serves to force the gasoline through the apparatus. The handle of the pump is connected to the lid in such a way that the gasoline is never left exposed to the air when the cleansing machine is not in use. In other words, the device is sufficiently fool-proof to diminish the fire risks, for one of the fruitful sources of fires and explosions is the evaporation of volatile oils.

The machine is made ready for use by merely pouring into it a gallon of gasoline or oil and then working the pump, while the part to be cleansed is placed in the swiftly moving liquid. Fire underwriters heartily endorse apparatus of this kind because it eliminates dangerous and wasteful methods of cleansing.—*By H. C. Ridgely.*

A Bumper That Locks the Car

THE cautious driver considers that he must have a bumper; and the cautious owner feels equally inclined to provide some means of securing his car against the activities of the person who might help himself to it. That both these ends can be served at the same time is indicated by the picture herewith, which shows a combination bumper and car-lock. The photograph shows the device in use as a lock, the two horns at the ends of the bumper being engaged with the wheel in a manner which would make driving the car in other than a geometrical straight line out of the question. They are secured in this position by a standard lock, whose location is revealed by the key in the picture. When it is desired to retire them from action as theft-preventives, they are unlocked and swung down out of the way, adding a rather artistic touch to the fender.

The bumper-lock in position to prevent the car's being driven. When unlocked the horns swing down out of the way

A Cotter-Pin Extractor That Does the Trick

THERE was a time, before the advent of the automobile, when nobody but the machinist was called upon to worry about cotter-pin extraction, or to anathematize the fact that no means of holding a nut in position against vibration had been devised which was more easily removable when it was desired to remove it. But with ten million cars in use in the United States alone it is now quite otherwise, and the balky cotter pin must go down in history as one more sample of "the eternal cussedness of inanimate objects," and as a close competitor of the fugitive collar button and the barking dog in the provocation of profanity.

Various tools have been offered from time to time for the extraction of the cotter pin. Some of them have given reasonable satisfaction, others have not. Few if any have been at the same time so simple, so easy of operation, and so sure of producing results as the one illustrated herewith. Our picture shows a test which we staged ourselves, and which is rather more severe than it appears. When a cotter pin is inserted in a hole that is part of a large, bulky object like an automobile, its removal consists for the main part in getting hold of it. Once we do that, the inertia of the object through which it passes is such that a good pull is almost certain to bring it out or to break it off. The case is otherwise in our picture. We have passed the cotter through the hole in an old rusty lock, and we have not fastened the lock to anything at all. Yet the long, tapering, horn-like member of the extractor gives such a firm leverage against this object, utterly lacking in inertia, that a good squeeze on the handles of the tool made the cotter walk right out as though the hole were anchored to the Woolworth Building, without the slightest tendency on the part of the hole to follow it and defeat extraction.

As further test of this handy little extractor, we took it home and used it on our Tin Lizzie. Any cotter that is not so badly crushed down as to afford no opening for the short prong of the extractor is completely at the mercy of the wielder of the tool. And for a rough-and-ready pliers or pincers job that requires no great accuracy of grasping—like twisting a jammed dust cap off the valve stem—it makes a very satisfactory pliers as well. On every ground it is a mighty handy tool to have around the garage.

A successful test of the cotter-pin extractor that was more severe than a first glance would suggest

A Standardized Dish for Laboratory Weighing

A CHICAGO manufacturer has recently developed a standardized weighing dish for laboratory work. By averaging the weight of a number of dishes the standard weight is determined. Each dish is then weighed with the equalizer attached. This equalizer is in the form of an ear and fastens to the dish near the upper edge. If the dish is found above the standard weight selected the cap of the equalizer stud is ground in order to remove enough metal to bring the dish to the standard weight. If the weight of the dish is below standard the cap is removed from the stud and powdered lead is placed in the tiny container until the weight is brought up to standard.

These dishes are found most useful in making fat and moisture determinations in any milk product. The ear makes it possible to counterpoise each dish so that any number of dishes may have exactly the same weight. The advantage of not having to correct a complicated series of weighings for the weights of the vessels is a material one.

Characteristic Soft X-rays from Arcs in Gas Vapors

EXPERIMENTS have been conducted in which soft X-rays having wave lengths longer than those previously known were produced and their wave lengths determined. These X-rays differ in many ways from X-rays as probably understood. Thus, the X-rays which were first discovered were remarkable for their ability to pass through solid bodies which were opaque to ordinary light. All known substances, including even ordinary air, are, however, opaque to these soft-X-rays, which can only be detected by their effect upon objects located inside of the vacuum tubes in which the rays are produced. All of the chemical elements can be made under proper conditions to give off radiations which are characteristic of the element. Some of these radiations are visible light, and some are in the range of X-rays. The radiations here described are the softest, longest-wave-length X-rays characteristic of several of the elements.

Measurements have been made in 12 different gases and vapors. These experiments are of interest because they partially close the gap between visible light of the shortest and X-rays of the longest wave lengths previously made. It has been known for a long time that radio waves and light waves are both electromagnetic waves differing only in wave length, and about 10 years ago X-rays were found to be very short waves of the same kind.

The radio waves ordinarily used are measured in meters, and there is only a very small gap between the shortest radio wave and the longest heat waves; the latter have a wave length of about 0.3 mm. From the longest heat waves down to ordinary light waves, which have a wave length of a few ten-thousandths of a millimeter, there is no gap, and, indeed, measurements in the ultra-violet have been extended down to wave lengths only a little longer than 0.00001 mm. There was, however, a gap between this and the longest known X-rays which were a little more than 0.000001 mm. in wave length. The present measurements nearly close this gap as some of the X-rays measured are of greater wave lengths than are the shortest ultra-violet radiations.

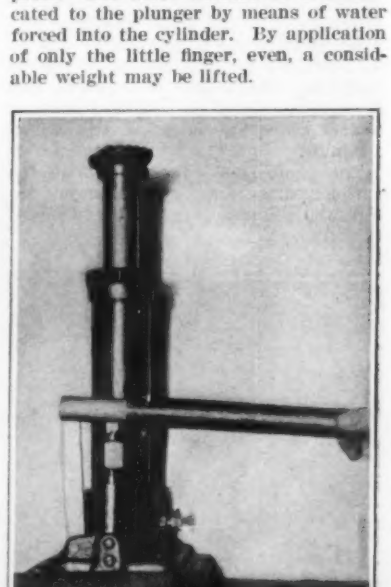
The dish that is bound to weigh what it ought to

Physical Properties of Pure Platinum

THE Chemical Division of the Bureau of Standards in cooperation with the Heat and Optical Divisions, has developed methods of obtaining platinum and some of its alloys in a state of extraordinarily high purity. A very sensitive test for the purity of platinum is afforded by the measurement of its "fundamental coefficient"—that is, the mean change of resistance per degree Centigrade in the interval 0° to 100° C. Some measurements of the fundamental coefficient of this recently produced platinum wire have shown values as high as 0.003922. The highest hitherto recorded value of this coefficient was 0.003917. This slight improvement in the performance of the resistance member of a precision electrical instrument is of great importance to the engineer who usese it and the designer who makes it.

Autojack That Works Like a Hydrostatic Press

THIS automobile jack is really nothing more than a miniature hydraulic press. Power and pressure are obtained in precisely the same way as in the press. The force exerted is communicated to the plunger by means of water forced into the cylinder. By application of only the little finger, even, a considerable weight may be lifted.



The hydrostatic jack

The Heavens in March, 1922

The American Association of Variable Star Observers; Its Work and Its Needs

By Professor Henry Norris Russell, Ph.D.

THE advancement of most of the sciences is made exclusively by men who have chosen this field for their profession. They may be, and usually are, teachers as well, or perhaps they will be able to utilize their abilities to financial advantage in the practice of their profession, as in engineering and medicine. But, in almost all instances, no man can hope to add anything of consequence to the sum total of scientific knowledge which already lies within our grasp unless he has had an extensive and exacting technical training.

This rule, like many other good ones, has its exceptions. In some fields, even of science, the amateur still holds his own, and can make contributions which are useful, and at times important. The great examples of this at the present day are found in the realm of astronomy. Although some branches of the science demand severe training, and mathematical ability beyond the average, even in order to understand the work of others, there are lines in which the man without such training may do valuable service, provided only he has love of the work, patience to continue in it, the use of a small telescope, and the simple knowledge which enables him to find the stars and interpret what he sees. Not many months ago we spoke of one such field of usefulness for amateurs—the discovery of comets, which now is seriously neglected.

The comet-seeker, however, may spend months, or even years, at the work before he is rewarded by a discovery. To one type of mind the knowledge that such a discovery, when it comes, will give his name a permanent place in the annals of science is motive enough for the long search; but to another type work is more attractive which assures of securing results of scientific value for each night's work, even though they may not be spectacular, or afford an "undying name."

Such opportunities are found in the observation of variable stars. Many hundreds of stars are now known to vary in brightness, and every one of them deserves observation. When we know what physical processes are going on—as in the case of the eclipsing variable like Algol—we can use the observations to find out various things of importance, such as the size, shape and brightness of the stars involved. In the more numerous cases—including most other types of variables—in which we are still uncertain or quite in the dark regarding what is really happening to cause the changes in brightness, observations are even more important; for it is only by collecting facts that we can obtain any rational basis for future theories, and only by studying all the available stars that we can come upon those which, by some peculiarity in their behavior, are especially suited to test our theories and lead us to a deeper understanding.

The isolated amateur, even if he has a good telescope of fair size, is at a serious disadvantage in undertaking such work. To identify the stars which he is to observe he needs star maps, and maps showing the telescopic stars are not cheap or easy to obtain. He will estimate the brightness of the stars which he is watching by comparison with other neighboring stars of constant brightness; but the measurement of the light of those stars is a hard task for the amateur. Moreover, after his work is done he may find that someone else has all the time been observing the same star, duplicating his work, while some other stars, perhaps of greater interest, have gone unwatched.

Organizing the Work

In order, therefore, that the work of amateur astronomers may attain its full value, some scheme of cooperation is necessary. The first attempt at such cooperation was made in England by the British Astronomical Association. It was followed soon, and very successfully, in this country by the American Association of Variable Star Observers. The Association was launched in 1911, with only seven members, but has proved so useful and successful that its members now number nearly 300—mostly in the United States, but some in other countries all over the globe.

Anyone who has a small telescope—three inches or more in aperture—and desires to observe variable stars, is cordially welcomed as a member. The Association will supply him with detailed descriptions of the methods of observing which have been found most valuable, with blanks for recording his observations, and most important of all with photographic charts of the region near each variable star—charts on which are marked the variable, and a set of comparison stars. The magnitudes of these stars have been determined by observation at Harvard, and are marked on the chart.

In return, the amateur is requested to send a monthly report of his observations to the central office of the Association at Harvard, where they are collated and sent month by month to *Popular Astronomy* for publication. In this way each observer can check up his results with those of others, and see, too, what stars need more observations than they are getting. During the past ten years the members of the Association have contributed more than 120,000 observations.

What Amateurs May Do

There is hardly any type of variable star upon which amateurs may not make valuable observations. Even among the eclipsing variables, for which precise observations with large telescopes are most important, there are many whose periods are not yet known. The watch on such stars, night after night, until they have been "caught faint" often enough to determine the true period, is most profitably made with a small telescope. Similar remarks might be made about the regular variables of short period; but the great field of the Association lies among the long-period variables which form the majority of all known variable stars. For these objects, the estimates of brightness by an observer of a reasonable degree of practice are satisfactory for all present purposes, and they are so numerous that the professorial staff of the observatories of America would hardly have time to follow them all if they had little else to do. The splendid mass of observations which are now being secured by the association of amateurs affords by far the best base that has ever appeared for a study of the very interesting and difficult problem of the cause of the variation.

Still more interesting are certain irregular variables: for example, *ss Cygni*, a star which is usually of the twelfth magnitude, but brightens up almost overnight to the 9th at irregular intervals of about sixty days. A close watch has been kept on this star for years, and on the two or three other stars which behave in the same way.

Such a rapid outburst of light makes one think of the "new stars" or novæ. Is *ss Cygni* a sort of recurrent nova, undergoing the same sort of changes, to a less violent degree, and oftener? Our best hope of an answer would come through the spectroscope; but the star is so faint that the great Mount Wilson telescope alone could tackle it. By mutual arrangement, last summer, the variable star observers agreed to telegraph to Mount Wilson when the sudden brightening of the star was observed; and thanks to this information, Adams secured spectra which, though very peculiar, showed a certain resemblance, in the presence of enormously widened lines, to those of novæ in certain stages.

But the work of the "A. A. V. S. O." does not stop here. Arrangements are sometimes made for the loan of telescopes, not employed at the time, to observers who will make good use of them. Many observatories have a number of small telescopes which are lying idle, and have gladly lent these to amateurs whom they had reason to believe to be ready to use them in real astronomical work, and not for mere star-gazing. A library of astronomical books is also maintained, from which members may borrow works which they may need.

To extend these varied and very useful activities the Association is now seeking to raise an endowment. Rooms for the use of the Association and a dome in which to house the largest telescope that belongs to it will be provided at the Harvard Observatory—leaving the income of the endowment almost wholly "free," without "overhead," for the support of the present and projected research work of the Association. This plan promises so excellently that it appears quite proper to diverge for a moment from the usual policy of these columns, and suggest that any friends of astronomy who are able to aid in it, either by observations of their own or by financial aid, should communicate with the Secretary of the Society, Mr. W. T. Olcott, of Norwich, Conn.

At 11 o'clock: Mar. 8
At 10½ o'clock: Mar. 16
At 10 o'clock: Mar. 23

At 9 o'clock: April 7
At 8½ o'clock: April 14
At 8 o'clock: April 22

At 9½ o'clock: Mar. 29

NIGHT SKY: MARCH AND APRIL

The Planets

Mercury is a morning star all this month, and is farthest from the sun on the 12th, when he is 27½° away. Being to the south of the sun, he does not rise so early as he would otherwise do, but even so he gets up an hour before the sun, and should be fairly easy to see.

Venus is an evening star, just past conjunction, and sets about 6:40 P. M. in the middle of the month. She is so bright that she should be easy to see in the twilight.

Mars is in Scorpio, moving slowly eastward in the heavens approaching us, and growing brighter. By the end of the month he is only eighty million miles away and looks as bright as Arcturus.

Jupiter is in Virgo, a little west of Spica, and comes to the meridian at 1:30 A. M. in the middle of the month. Saturn, which is in the same constellation but about 10 degrees farther west, is in opposition on March 25th.

Uranus is just past conjunction with the sun, and is invisible. Neptune, on the contrary, is well placed in Cancer, in R. A. 9h. 5m. 33s., Dec. plus 16° 47′ on the 2nd, and 9h. 3m. 24s., plus 16° 56′ on the 30th.

The moon is in her first quarter at 2 P. M. on the 6th, full at 6 A.M. on the 18th, in her last quarter at 4 A. M. on the 20th, and new at 8 A. M. on the 28th, during the eclipse. She is nearest us on the 28th, and farthest away on the 25th. During the month she comes into conjunction with Neptune on the 10th, Saturn and Jupiter on the 14th, Mars on the 18th, Uranus and Mercury on the 26th, and Venus on the 29th. The conjunction with Jupiter is fairly close.

There is an annular eclipse of the sun on the 28th, which just gets into the class of those visible in the United States. The northern limit of partial eclipse includes Florida and the West Indies and, on the other side of the ocean, takes in nearly all of Europe.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—B. B. WOOD, 1798 La Fond St., St. Paul, Minn. The invention relates generally to an airplane designed to carry a large number of passengers and which is provided with planes constructed and arranged to form efficient sustaining means and which are adapted to form a parachute for retarding the fall of the airplane to the ground in the event of an accident, such as the failure of the motor to continue its operations. A further object is the provision of pontoons to permit of its functioning as a hydroplane.

FLYING MACHINE.—C. E. and W. G. HICKS, address Chas. E. Hicks, Mechanicville, N. Y. The invention relates to a flying machine of the helicopter type, which shall present lifting surfaces capable of exerting a maximum pull with but a minimum effort. An object is to provide a device of this character in which the pull exerted by the lifting elements will be constant, irrespective of the speed with which the same is operated. The machine comprises a plurality of lifting elements arranged in spaced relation to and above one another. (See Fig. 1.)

Pertaining to Apparel

CONVERTIBLE GARMENT.—I. WHEELER, 22 West 15th St., New York, N. Y. An object of the invention is to provide a convertible garment more especially designed for wear by children and arranged to combine bloomers, a waist and a dress to permit wearing the dress with or without the bloomers or the bloomers without the dress. Another object is to permit of conveniently opening the garment for sanitary purposes.

Chemical Processes

COMPOSITION OF MATTER.—M. WEINBERG, 48 Hawthorne St., Brooklyn, N. Y. This invention has particular reference to a composition of matter for use as a rust preventive. An object is to provide an economical, simple and efficient composition in the form of a paste which can be used when mixed with water, preferably as an antirust solution for metallic surfaces, especially cutlery. The composition comprises ordinary soap, sodium carbonate, glycerin and formaldehyde.

EMBALMING PROCESS FOR DEODORIZING.—T. B. BARNES, 24 W. Sixteenth St., New York, N. Y. Among the objects of the invention is to provide a method the practice of which will result primarily in the destruction or neutralization of insanitary or offensive odors, and the process includes such treatment of the body as will tend to render it stable or in such state of preservation as to not give off odors subsequently.

PROCESS OF TREATING AND RECOVERING FOR REUSE OILS, RESINS, GUMS, ETC., WHICH HAVE BEEN HARDENED. C. LITTLETON, c/o Special Process Co., Hopewell, Va. The invention relates to the recovery and use of oils, and the like which have been used as paints or varnishes, or which have been otherwise dried or hardened. The process consists of dissolving or suspending the hardened material in an alkaline solution and there treating it with active chlorin, and then exposing the treated material to a current of air. This material may be ground up for reuse.

QUININ SILVER-PHOSPHATE COMPOSITION AND PROCESS OF MAKING SAME.—R. L. CROWE, c/o University of Tennessee, Memphis, Tenn. The invention has reference to germicidal silver, and more particularly to a composition which contains phosphoric acid combined with silver and alkaloidal quinin. An object is to produce a germicidal silver salt which may be used instead of silver nitrate. The process comprises dissolving freshly precipitated silver phosphate in syrupy phosphoric acid and adding alkaloidal quinin to the solution to complete saturation.

Electrical Devices

TELEPHONE ATTACHMENT.—J. P. LEE, 104 Washington Ave., Pleasantville, N. Y. The invention relates to a telephone attachment by means of which it will be possible to prevent any sound from entering the transmitter mouthpiece when it is so desired, without the necessity of placing one's hand over the transmitter, and the device when applied virtually prevents the entrance of any dust, thus retaining the instrument in a thoroughly antiseptic condition.

CABLE SECURING DEVICE PARTICULARLY APPLICABLE TO THE FIXATION OF ELECTRIC CABLES ON CARBON-BRUSHES.—E. GINDRE, 12 Rue de Lorraine, Lewallois-Perret Seine, France. This invention has for its object a device for fixing an electric cable on a carbon-brush, the device being combined in such manner as to insure a perfect contact and fixation whatever may be the heating to which the connection may be subjected. The loss by contact with this connection is reduced to a minimum, and it is not exposed to injury either by any oxidation or by heating of the carbon-brush.

ELECTRICAL FUSE.—H. SNODGRASS, Box 135, 21 School Hill, Bisbee, Arizona. In general this invention comprises a cylindrical casing of insulating material which is split longitudinally and which has on each end the usual metallic cap which is likewise slit. Clamping means on each end which are easily operated hold the two split portions together. The fuse link is held within the casing and when burned out is easily removable by releasing the clamping means and separating the casing. (See Fig. 2.)

GAS GENERATOR.—M. BOISEN, 1511 Camp St., Sandusky, Ohio. An object of this invention is to provide a construction and arrangement of apparatus for electrically decomposing water to generate oxygen and hydrogen and direct these gases through separate outlets to any desired containers or point of use. The generator comprises a tank, cells in the tank, hollow metal electrodes in the cells, the cells having gas outlets in their upper ends.

ELECTROLYTIC CELL.—J. CRANSTON and W. D. LE BAR, address John Cranston, Trenton, Mich. An object of the invention is the provision of a cell which is simple, compact and efficient, and is capable of ready assembly and disassembly. Another object resides in the provision of means whereby the anode structure can be adjusted relative to the other parts so that the functioning of the anodes can be considerably prolonged, and means whereby the chlorin, the alkaline liquor and the hydrogen gas evolved during the operation of the cell can be very readily collected.

FLASHLIGHT GENERATOR.—W. W. ANDERSON, Box 105, Michigamme, Mich. This invention aims more particularly to provide a device in which the source of electrical energy is derived by a hand-driven generator, the construction being such that it is not necessary to continuously operate the mechanism to produce a steady stream of light. The device is provided with a plurality of flywheels associated with the armature to provide an even speed when operated. The invention is simple in construction and may be manufactured at a relatively small cost. (See Fig. 3.)

Of Interest to Farmers

CATTLE STANCHION.—D. B. COATES, Payette, Idaho. The purpose of this invention is to provide a stanchion of extremely simple, durable and inexpensive construction having a locking lever permanently carried by the stanchion and operable to automatically lock the stanchion in contracted position. The stanchion is supported for universal movement so as to conform to the movements of the animal.

QUEEN BEE REARING DEVICE.—W. B. YATES, Ventura, California. The invention has for its object to provide mechanism especially adapted to facilitate manipulation in queen bee rearing to permit the various manipulations necessary in such rearing, without leaving the hive open and exposed to weather or robber bees. In the invention each cell is independently supported. When it is desired to examine a cell it is only necessary to lift the top from the hive and remove the cell required.

PINK ROLL WEEVIL DESTROYER.—J. M. Webb, Flat, Texas. The invention relates to a pink boll weevil and worm catcher and destroyer, and is particularly adapted for use in connection with the raising of cotton plants, so as to rid the plants of these injurious pests in a convenient and effective manner, the device being so constructed as to permit it to be readily applied to cultivators through the medium of the beams thereof.

SELF-FEEDER FOR HAY PRESSES AND THRESHERS.—E. O. STANCLIFF, R.F.D. No. 6, Bakersfield, Cal. The foremost object of the invention is to provide a self-acting feed mechanism either for hay presses or threshers, so arranged as to automatically take care of the material without supervision of an operator. A further object is to provide a feeder embodying means for automatically regulating the feed, and periodically dividing the hay or other material being fed, so as to deliver uniform quantities.

CORN PLANTER.—E. A. GOLLE, Grand Beach, Mich. An object of this invention is to provide a corn planter in which the means for controlling the dropping of the seed can be operatively connected at will with a traction-operated member of the device, thereby causing seeds to be dropped when the device is drawn forwardly. A further object is to provide means for controlling the dropping of the seed, means for making the seed rows, and means for covering the seed which has been dropped.

STUMP PULLER.—W. W. BISSELL, 2529 Grand Ave., Milwaukee, Wis. An object of the invention is to provide a device for pulling stumps which is so arranged as to permit of pulling a plurality of stumps at one time. A further object is to provide means by which the stumps are pulled from opposite directions, so that the stumps on one side afford an anchorage for pulling the stumps on the other side. A still further object is to provide a tractor with a plurality of drums for drawing in the cables which pull the stumps, each drum being independently controlled.

Of General Interest

TRUNK CONSTRUCTION.—D. B. HART, 121 St. Nicholas Ave., New York, N. Y. The object of this invention is to provide a trunk of the sectional type especially adapted for use by traveling salesmen, the independent sections being capable of being nested and locked to each other, thus preventing their being separated and lost. A further object is to provide a trunk including adjustable means for connecting and locking any number or all of the sections together. (See Fig. 4.)

SANITARY WARDROBE SHELF.—J. FORESTER, 1987 Madison Ave., New York, N. Y. Among the objects of the invention is to provide a shelf of such nature that there is no place for dust, dirt or vermin to accumulate and be held, to provide a shelf having attachment or hanging means of such nature as to be easily applied to the supporting walls to effectively support the shelf, and means for the attachment of an extension to the main part of the shelf so that the main and extension parts will be perfectly flush.

STAGE-COSTUME APPLIANCE.—H. SKREMKA, 253 W. 85th St., New York, N. Y. The aim of the invention is to provide a stage costume appliance by means of which novel and spectacular effects may be achieved. An object is to provide a device which shall be relatively simple and by means of which the costume may be caused to be manipulated to produce an illusion which shall be pleasing to the eye. A further object is to provide means for supporting the device in such manner that no discomfort will result to the wearer.

COLLAPSIBLE SEAT FOR CHILDREN.—W. V. HOLLEY, 103 Chambers St., New York, N. Y. An object of the invention is to provide a simple, strong and easily collapsed commode seat. A further object resides in the provision of a structure wherein in assembling the seat a minimum amount of time and labor is required, whereby the seat can be easily made ready for immediate use.

METHOD OF CONSTRUCTING REINFORCED CONCRETE STRUCTURES.—E. VAN BAVEGEM, Oosterzeele, Belgium. The invention relates to reinforced concrete

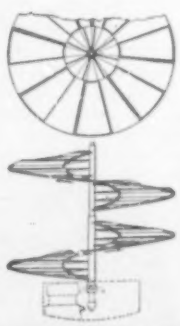


Fig. 1. The constant-lift helicopter, designed by C. E. and W. G. Hicks

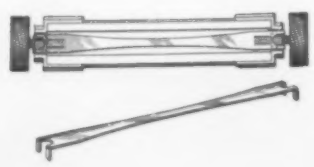


Fig. 2. Electric fuse with easily renewable fuse member, patented by H. Snodgrass

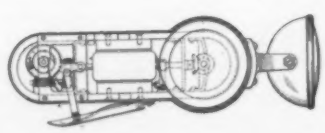


Fig. 3. Economy is the idea behind W. W. Anderson's flashlight generator

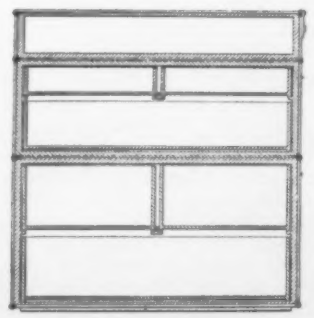


Fig. 4. The novel trunk construction invented by D. B. Hart

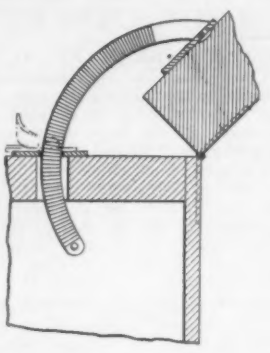


Fig. 5. Holder for hinged window frame, put out by W. L. Burtis

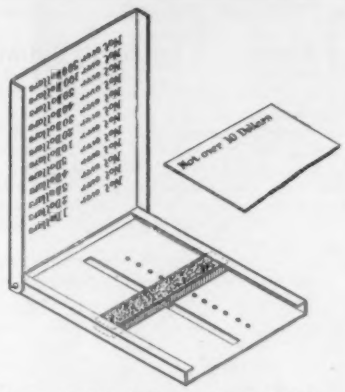


Fig. 6. Pocket check protector devised by O. K. Linscott

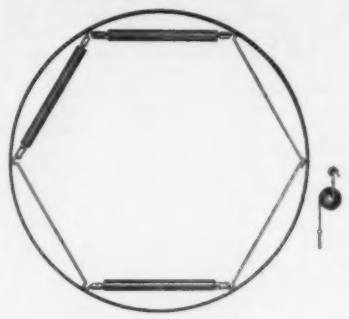


Fig. 7. Disappearing curtain for lampshade use, patented by H. A. Kurre

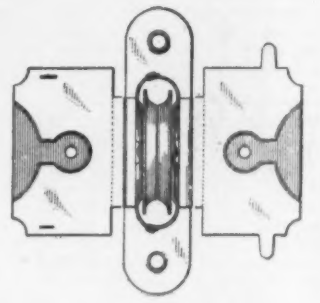


Fig. 8. Housing and attaching flange for sash pulleys, designed by W. F. Krueger

structures in which hollow walls are molded complete in a horizontal position with window casement and door frames, and cornices where required. The complete building forms thus a unitary structure made up of ready molded monoblock sections, and the labor of erection is made as simple as possible.

CAMERA.—T. GALLO, 244 E. 13th St., New York, N. Y. This invention relates to a camera which will have as one of its objects the provision of a ground glass plate by means of which the camera may be focused accurately, whether a roll film or plate is intended to be used, without resorting to the necessity of removing the film. A further object is the construction of a camera which will be capable of receiving either roll film, plates or cut film at the option of the user.

POULTRY FEEDER.—C. J. PFEIFER, Box 54, R. F. D. No. 1, Calicoon, N. Y. The invention is particularly designed as a device for feeding grit or ground oyster shell, although it may be employed for feeding grain or similar food. The principal object is to provide a feeder with means for sifting the contents of a gravity feed hopper whereby the dirt, husks or other foreign particles are eliminated during the feeding operation.

TOOTHBRUSH HOLDER. — C. B. BAKER, c/o Miss. Dental Association, Armory, Miss. The object is to provide a receptacle which receives the tooth brush and protects the same from contamination by dust, dirt or the like while exposing it to the advantageous action of light, which provides a separate compartment for each brush, and which is in all respects sanitary and hygienic, and may be readily attached to any convenient support.

FORM LIFTER.—L. M. CONVERT, c/o J. M. Updergraff, 1620 Second Ave., Peoria, Ill. This invention has for its object to provide a device especially adapted for lifting and supporting concrete forms, used in building construction, wherein the lifter is adapted to be connected with the form and has means for engaging a supporting rod or pipe so arranged that the lifter carrying the form may be moved up the pipe and will hold the form in adjusted position.

COIN HANDLING APPARATUS.—S. J. BRUNE, Disbursing Officer, U. S. Naval Training Station, Hampton Roads, Va. One of the foremost objects of the invention is to provide a method of handling large quantities of coins, a preferably rectangular or square box being used to hold the coin, and being so arranged that stacks of coin can be readily shoved out for distribution. A further object is to provide a box, the lid of which is sealed and having the amount contained therein indicated in some convenient place, and the coins so arranged that the individual rows can be inspected in order that a balance may easily be calculated.

PIPE JOINT.—H. G. PLUMMER, 323 Security Bldg., Galveston, Texas. The invention relates particularly to joints of the ball and socket type adapted for use in dredge floating pipes. The purpose is to provide a joint which is flexible under any and all conditions, effectively lubricated, and one which successfully withstands all stresses to which it may be subjected.

RECEPTACLE AND CARRIER FOR EGGS.—R. M. ODELL, Box 82, Leavenworth, Kansas. The primary object of the invention is to provide a receptacle capable of use with shipments of eggs in the ordinary egg case which will prevent breakage of eggs, which will provide for a free circulation of air in cold storage and which will allow of readily examining the eggs while in transit or storage. A further object is the provision of a filler in the nature of a tray having a series of attached egg pockets, the tray being adapted to fit the ordinary egg case.

PEN AND PENCIL CLIP.—R. MOORE, 354 Hunter St., Ossining, New York. The invention has for its object to provide a clip form mounted upon a pen or pencil for use in quickly and easily securing the same in the pocket of the user. The clip detached from the pen or pencil can be applied to the edge of the pocket, and left there when it is desired to use the pencil without the clip.

SPUR.—P. M. KELLY, Dalhart, Texas. An important object of this invention is to provide means whereby the attaching buttons on a spur may be swingingly connected to the band of the spur in such manner that the same will lie flatly in contact with the ankle portion of the boot so as not to scrape or wear the boot. A further object is to provide means whereby the swinging button attached to the arm of the spur may be readily renewed.

TEA OR COFFEE POT.—B. F. OLSEN, Box 1274, Spokane, Wash. The invention comprehends a coffee or tea pot which is provided with a pair of diametrically opposed handles and spouts, so that the same may be passed from one person to another without setting the device down, and the person passing the same can maintain a hold until the person receiving the same has tightly grasped it.

EGG CARTON.—R. M. ODELL, Box 82, Leavenworth, Kan. The present invention relates more particularly to devices for safely packaging eggs for transportation or parcel post service, the object being the provision of a device by means of which the eggs may be shipped without danger of breakage in separated cup-shaped cells, and which when disposed within a cover or the like forming a carton proper, will act as a brace to prevent collapsing. A further object is to provide a device in which air, heat, cold or moisture may be excluded from the package thus doing away with the necessity of cold storage.

BAG.—C. J. FREESE, 547 Broad St., Elyria, Ohio. The invention has particular reference to a bag which is produced preferably from cheap material and which includes a closing flap with a handle associated with the flap for carrying the bag. The primary object is to improve the construction of such bags, especially the means for fastening or anchoring the handle.

BARREL PROTECTOR.—W. F. MEEK, c/o Tex Oil and Gas Co., Apartado 152, Tampico, Mexico. The aim of this invention is to provide a device particularly adapted for use in connection with barrels, and by means of which the barrel may be braced and generally strengthened to withstand the shocks incident to handling in transportation. An object is to provide a brace or protector which shall be of simple construction and permit of instantaneous application, and without adding to the space occupied by the barrel.

CASEMENT HOLDER.—W. L. BURTIS, 449 New Rochelle Ave., Bronxville, N. Y. This invention relates to means for securing a hinged window frame at any desired position of adjustment, an object being to provide a casement holder in the form of a curved bar having serrated surfaces, and provided with means for engaging the bar to secure the window against movement. A further object is to provide a device of this character which is simple and inexpensive, yet durable in use. (See Fig. 5.)

RANGE FINDER.—L. GINZBOURG, 152 Chestnut St., Jersey City, N. J. The invention relates more particularly to a device especially adapted for finding the distance of objects in order that a camera may be properly focused. The primary object is to provide a device which is small and therefore easily portable, and by which the distance between the camera and the object to be photographed may be ascertained with sufficient accuracy to enable sharp focusing of the picture.

PRICE TICKET HOLDER.—L. and H. HOPP, 230 West 17th St., New York, N. Y. One of the principal objects of the invention is to provide a price ticket holder in which price indicating means may be retained against accidental displacement or movement of the holder, thereby providing a holder in which the several elements are at all times in proper position. A further object is to provide a holder especially adaptable for use with flexible and interchangeable price tickets.

POCKET CHECK PROTECTOR.—O. K. LINSCOTT, Tekoa, Wash. The invention has reference more particularly to a small and compact device which may be carried upon the person so that it may be handy for use in preventing fraudulent alterations in bank checks and the like. The device comprises a pair of plates, the inner face of one plate having a series of fixed printing characters and the other plate having a movable inking device adapted to cooperate with the printing characters to reproduce any one of the series on a check when presented between the plates. (See Fig. 6.)

DOMESTIC COOKING VESSEL.—G. W. WATTS, 702 Central Ave., Merchants' Cafe, Hot Springs, Ark. The object of the invention is to provide a domestic steam cooking vessel which is highly efficient in use in that it conveys the steam from the generator chamber to the container for the substance being cooked without exposing the steam to the possibility or danger of being condensed, and which delivers the steam to the bottom of the container whereby the steam rises upwardly through the substance to be cooked.

CURTAIN FOR LAMPSHADES OR DOMES.—H. A. KURRE, 349 7th St., Brooklyn, N. Y. The invention has for its object to provide a curtain designed for use in connection with lampshades or domes and arranged to permit the user to readily shade the eyes against direct rays of light emanating from the burning lamp. Another object is to provide a spring-controlled curtain which may be quickly attached, and which is normally in inactive, out-of-sight position, but can readily be drawn into active position to form a shade. (See Fig. 7.)

Hardware and Tools

ADJUSTABLE BIT.—T. G. DOYLE, 345 Hanover St., Fall River, Mass. An object is to provide a bit with an adjustable bar carrying the spur at the operating end of the bit and secured in its position of adjustment by means of the same screw which is utilized for securing the cutter plate at its proper adjustment. A further object is to provide a bit having removable spurs, one of said spurs constituting a portion of the cutting plate and the other removably clamped against the bit by means of the securing means of the cutting plate.

SAFETY DOOR FASTENING.—J. M. REED, 19 Kossuth St., Brooklyn, N. Y. An object of the invention is to provide a construction which will not be in the way when not in use, but will effectively resist opening the door beyond a certain extent when in use, the idea being to produce a device which will take the place of the ordinary door chain, but which may be adjusted to lock the door in a partially open position.

PULLEY CASING.—W. F. KRUEGER, 2184 Canalport Ave., Chicago, Ill. This invention relates to a housing and attaching flange for sash pulleys. The prime object is to simplify and cheapen the construction of sash pulleys to which end it is proposed to produce the housing and attaching flange of the pulley from a single sheet of material, the parts being so arranged that they may be stamped from the sheet in a single operation, and bent in such manner as to properly support the axle of the pulley for free rotation. (See Fig. 8.)

FISHING TOOL.—C. H. BROWN, Box 732, Breckenridge, Texas. This invention has for its object to provide a tool for finding and removing undesirable objects from wells, as, for instance, broken bits, pieces of stone, and the like, wherein a body is provided having a series of barbed holding rods normally extending below the body and resiliently supported to permit them to yield when directly engaging the article to support the same during removal.

CURTAIN ROD.—J. B. AKERS, 20 Camp St., Newark, N. J. This invention relates to rods adapted to support curtains in juxtaposition to the window at the inside of the same, being so mounted as to swing at right angles, or clear of the window in order to afford maximum ventilation and light ingress. The device is adjustable to windows of various widths and may be swung to permit of convenient cleaning of the window-panes. It may be easily mounted in position for use.

Heating and Lighting

MERCURY VAPOR LAMP.—M. J. CORNU, 26 Rue de Babylone, Paris, France. This invention has in view more particularly a damper of the oscillations of the mercury, an arc-striking device and various constructional forms of current-supply arrangements. This lamp possesses the property of being able to strike its arc just as well by mere rocking as by the action of the expansion of the gas under the influence of the heating lamp.

RELIEF-VALVE.—H. W. JUSTUS, Napanoch, N. Y. An object of this invention is to provide a valve which will permit the escape of air from a steam system, and will automatically close and prevent the escape of steam therefrom. A further object is to provide a diaphragm-controlled valve which may be readily applied to a steam system, which will act quickly, will be simple and readily accessible in case it should need repair.

INDICATOR.—H. A. SODERBERG, 74 Bostwick Ave., Jersey City, N. J. The invention has for its object to provide an indicating mechanism which will facilitate the application of a needle to a phonograph record in the dark, by providing a luminous indicator associated with the record and with the needle arm of the producer, which will make it possible to quickly apply a needle on the outside edge of the grooved playing surface of the record.

OIL BURNER.—A. A. LINDLEY, 1728 West Riverside Ave., Spokane, Wash. The purpose of the invention is to provide a self-cleaning fuel-oil burner for use in connection with hot water and steam furnaces or the like, and so constructed as to prevent

clogging, but provided with means for cleaning the same out with steam or hot water in case of necessity. The device is provided with means whereby the regulation is automatic, according to the temperature of the heating plant. It also permits of the parts being easily cleaned and maintained in good order.

Machines and Mechanical Devices

ROCK DRILL SHARPENING DEVICE.—J. H. HINES, Sta. A., Box 134, Auburn, Calif. The invention relates to rock drill sharpening machines. The foremost object is to provide a machine having convertible mechanism therein and operated preferably by compressed air, for collaring a rock drill or for shaping and sharpening the cutting point. A further object is to provide an arrangement in the gripping jaws, enabling the reversal of the jaws for the purposes of collaring a drill in one position and sharpening the drill when in another position. (See Fig. 9.)

LINE MAKING ATTACHMENT FOR TYPEWRITING MACHINE. — R. G. PEREIRA, Box 927, Valparaiso, Chile. Among the objects of the invention is to provide a line-making attachment arranged to permit the user to quickly and accurately produce horizontal or vertical lines or combinations of the same, such as are used in making out diagrams, invoices and other typewritten matter. Another object is to permit of easily applying the attachment to various types of typesetting machines.

PLUME WASHING MACHINE. — I. TESSA, 78 Jefferson St., Brooklyn, N. Y. An object of the invention is to provide a machine having facilities for having attached in definite positions upon a carrier a large number of pieces to be washed, whereby the operation of the carrier and the units through a supply of water or other cleansing medium, the plumes will be thoroughly saturated and subjected to auxiliary means in the nature of scrubbers or agitators.

COMBINED RECORDER AND REGISTER.—R. B. CORMANY and A. F. HERRING, Box 85, Rome, Ga. This invention relates more particularly to a combined recorder and register for use with fluid-dispensing mechanism. The object is to provide a device which will make a permanent record of the fluid dispensed with respect to both volume and frequency of the flow, and will openly register the quantity of fluid dispensed, and will secretly register the volume of flow.

PORTABLE DERRICK.—W. S. GARRETT, 321 W. Marshall St., Richmond, Va. One of the foremost objects of the invention is to provide a portable derrick which is capable of being easily operated. A further object is to provide a portable derrick in which the steering, propelling, turning, revolving and load-lifting functions can be accomplished by one man, and whereby the load can be readily dumped from the lifting cradle by operation from the platform of the derrick. (See Fig. 10.)

DRILLING MACHINE.—G. K. ATKINSON, c/o Aurora Tool Works, Aurora, Ind. The primary object of the invention is to provide a drilling machine in which all of the moving parts are inclosed, thus protecting them from dust, dirt and the like, and at the same time affording protection against injury to the operator. A further object is to construct the machine in such manner that all the parts are readily accessible.

MILK BOTTLE CAP TUBING MACHINE.—P. P. SIMMONS, Huntington, Ind. The invention relates to a machine which is adapted to be used in connection with a milk bottle cap-making machine for the purpose of receiving the caps and packing them into a tube or other container. A specific object is the provision of a machine embodying a pair of oppositely rotating parallel screws spaced apart so that the bottle caps can be dropped into the space between the screws, whereby the threads convey the caps through a guide, which directs them into the container in an even manner.

MIXER.—G. C. TRUSLOW, Draper, N. C. An object of the invention is to provide a time and labor saving mechanism for mixing different classes of fibers, such as cotton and wool, or fibers of various colors. A further object is to provide a mixer which will be simple and practical in construction, strong, durable and efficient in use and comparatively inexpensive to install and operate. The device includes means whereby an air current passes through a continually swinging distributing arm to carry the mixed material into a feed pipe. (See Fig. 11.)

LAWN MOWER ATTACHMENT.—W. J. BOLL, Platteville, Wis. An object of the invention is to provide a means for adjusting the roller of a lawn mower. The invention is particularly designed for that type of mower wherein the roller supports the blade carrying frame, and by adjusting the roller the blade may be brought into close proximity to the ground to cut the grass short. A further object is to provide an adjusting mechanism which may be readily employed on lawn mowers of the usual types now on the market.

Musical Devices

PHONOGRAPH RECORD CABINET.—J. HEITMAN, 2305½ First Ave., Seattle, Wash. The aim of this invention is to provide a record cabinet having simple means whereby a desired record may be projected to a position from where it may be entirely removed from the cabinet. A further object is to render the ejecting mechanism inoperative while one of the records is removed from the cabinet so as to prevent the removal of additional records until the record which has already been removed is replaced.

DRUM EAR.—O. MEYER, 913 N. State St., Chicago, Ill. An object of the invention is to provide a drum ear which has means for preventing the slipping of the same along the drum cords. A further object is to provide a device of this type which can be quickly adjusted and which will not "stick" nor cut the drum cord. The device is simple in construction and operation, practical commercially and not likely to get out of order easily.

Prime Movers and Their Accessories

MANIFOLD.—H. W. ALLEN, 98 Safford St., Fresno, Calif. The invention has for its object to provide a device of the character specified especially adapted for use with carbureters for heating the vaporizing tube by means of exhaust gases, and for heating the mixture before it is delivered to the engine. The manifold not only heats the fuel before it enters the carbureter, but also heats the mixture as it passes from the carbureter.

AUTOMOBILE FUEL CUT-OFF.—E. S. KING, c/o H. P. King Electrical & Machine Works, Osgood, Ind. The invention relates to internal combustion engines. The object is to provide a cut-off which is controlled by the pressure in the lubricating system of the engine, which is effective to cut off the supply of fuel to the engine when the pressure in the lubricating system falls below the point at which a complete circulation is insured or dangerously exceeds the point of safe operation.

COMBINED INTAKE AND EXHAUST MANIFOLD.—G. F. CLARK, c/o Sherman Theater, Des Moines, Iowa. The present invention relates generally to gaseous fuel vaporizers and more particularly to a combined intake and exhaust manifold structure the arrangement of which is such that gaseous fuel for engine consumption will be intimately fixed and vaporized in its passage to the engine by the influence of the hot exhaust gases.

Railways and Their Accessories

LOCOMOTIVE JOURNAL LUBRICATOR.—J. G. B. PROUDFOOT, R. No. 5, Grafton, W. Va. A purpose of the invention is the provision of a lubricator which is adjustable to permit of its adaptation to journals and axles of various sizes, and which is so constructed as to render it easy of access. A further object is to provide a lubricator which may be readily removed and replaced from a journal box, and which insures reliable lubrication of the journal to prevent its becoming heated.

Pertaining to Recreation

TOY AIRPLANE.—L. J. PERKINS, Room 9, Beach Block, Lewiston, Idaho. An important object of the invention is to provide a toy airplane which may be thrown into the air for a substantial distance and which is caused to move in a circle or spiral path when descending. A further object is to provide a toy airplane having a pair of ballast weights which are automatically actuated when the airplane reaches the limit of its upward movement so as to operate the vertical and horizontal rudders. (See Fig. 12.)

GAME APPARATUS.—G. H. BUGENHAGEN, Weinrebe Bldg., Minot, N. D. An object is to provide a game similar to checkers in which the continuity of moving successively from square to square is interrupted by the provision of a central passage zone in the form of a cross, whereby greater mental effort is required in playing the game, consequently more enjoyment is derived therefrom.

GAME.—J. JOHNSON, Box 583, Menlo Park, Cal. The particular object of the invention is to combine the indoor game of billiards with the outdoor game of croquet or roque, in an outdoor game which will necessitate but minimum space and which may be utilized beneath awnings, tents or other covering. The prime object is the provision of a game board which will render possible the playing of a game embodying the above characteristics.

PLEASURE RAILWAY.—H. E. RIEHL, 1448 East Nineteenth St., Brooklyn, N. Y. The object of the invention is to provide a railway for use in pleasure resorts, parks, exhibition grounds and the like, and arranged to take up comparatively little space. Another object is to provide for safety of the passengers even should the car truck become disconnected from the car body containing the passengers.

Pertaining to Vehicles

DEMOUNTABLE WHEEL.—H. E. HOLLEY, Otisville, N. Y. The object of the invention is to provide a demountable wheel structure comprising a non-circular hub section carried by the axle, an abutment flange at its inner side, a reduced axial extension projecting from the opposite side thereof, a rotary non-circular member carried by the extension and capable of circumferential adjustment thereon to bring respectively the same into and out of register with the hub section.

VEHICLE WORK STAND.—G. W. ANDERSON, 248 Magnolia Ave., Elizabeth, N. J. This device is particularly designed for supporting motor vehicles in elevated relation with respect to the floor of a garage for effecting repairs. Among the objects is to provide a work stand which is equipped with means for retaining the vehicle in place thereon, said means being rendered active automatically by the running of the vehicle thereupon, the stand is also adjustable to accommodate vehicles of various sizes and types.

HAND WHEEL.—H. W. DOVER, Holywood, St. James, Northampton, England. The invention relates to hand wheels such as are employed for steering motor vehicles, for operating stop cocks, controlling aircraft, motor boats, gun mechanism, and other purposes. A special object is to provide an arm for a hand wheel bent from a sheet metal blank, the marginal portion of said blank being inturned and forming a diaphragm within the arm.

AUXILIARY TRACTION DEVICE FOR MOTOR VEHICLES.—A. H. GEDDES, 288 Clermont Ave., Brooklyn, N. Y. The prime object of the invention is to provide an auxiliary traction device by providing means for transmitting power from ditched or mired driving wheels to the remaining wheels. A further object is to provide means for retaining the steering knuckle spindles in alinement to insure an even traction on the driven wheels. The device may be applied to practically any standard make of motor vehicle, and set up for use in a minimum of time.

TRACTOR SAFETY DEVICE.—A. GUIGNARD and F. ROSIGER, Flood River, Oregon. Among the objects of the invention is to provide an attachment for tractors in the form of a hand lever which is controlled by the operator so that in the event of the operator being thrown from the seat of the tractor, the supply of gas will be either entirely or partially shut off to stop the tractor.

Designs

DESIGN FOR A GAME BOARD.—R. H. COTTER, 859 St. John's Place, Brooklyn, New York.

DESIGN FOR A BRACKET FOR THE HEAD RING OF AN ELECTRIC LIGHT FIXTURE.—H. SHLAMOWITZ, 1409 Forty-first St., Brooklyn, N. Y.

DESIGN FOR STATUETTE.—HELEN TYLER, address c/o Ho Thoi Sales Co., 102 West 40th St., New York, N. Y.

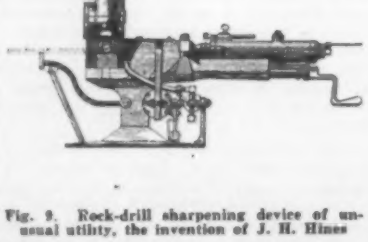


Fig. 9. Rock-drill sharpening device of unusual utility, the invention of J. H. Hines

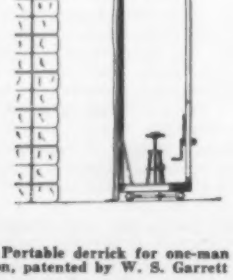


Fig. 10. Portable derrick for one-man operation, patented by W. S. Garrett

Fig. 11. Mixing device for cotton, wool and other vari-colored fibers, invented by G. C. Truslow

Fig. 12. Toy airplane of novel design, put out by L. J. Perkins

Miscellaneous Notes

Taxing Altitude.—The higher above the pavement Parisians live the higher taxes they pay. In place of the unpopular levy on pianos the stair carpets and elevators of apartment houses will be taxed. The more stair carpet or elevator you use the more you pay.

An Inland Lighthouse.—The lighthouse once off Atlantic City, well out to sea, is now 500 yards inland from the board walk, and surrounded by paved streets and apartment houses. In 50 years the shifting sands have added millions of dollars' worth of land to the northern end of the island.

A City of Storks.—In Angora, the capital of Nationalist Turkey, storks may be seen everywhere. One pair nest on the top of the column reared by the Romans in honor of Augustus; others on the roof of the Parliament building; several pairs make their home on the Hotel Huriet. Boys are brought up to let them alone. Indeed, Anatolia is a birds' paradise, for the Turks never shoot them or destroy their nests.

War Horses Are Honored.—Of 243,135 horses and mules with the American forces during the war, 68,682 perished. A bronze tablet in memory of the services of these, our four-footed defenders, was recently unveiled in the State, War and Navy Building. It was presented by Dr. Stillman, president of the American Humane Association, and was received on behalf of the Government by Major General Holbrook, Chief of Cavalry.

Heavy Demands on Hickory.—Hickory, with its unrivaled strength, elasticity and resiliency, is used for tool handles, for the spokes of automobile wheels, for golf clubs, and for many other purposes. There is increasingly keen competition among the industries for this wood, although there are still 15,784,000,000 board feet standing throughout the country. Manufacturers have to go farther for their supply, and really select stock is already very hard to obtain in the required quantities.

Shipping Cases for Rubber.—A new case for shipping sheet rubber has been introduced into Singapore shipping circles by an American firm. These reach local exporters in the form of sheets made of 100 per cent fiber, the riveting, packing and wiring being done by the shippers. The thinness of the sheets enables the cases built from them to hold from 12 to 25 per cent more weight of rubber than the old wooden boxes, and the new construction is practically unbreakable, very cleanly, and waterproof.

A New Stage Effect.—A Russian widow, Mme. Ivan Boutkovsky, has devised an ingenious scheme for "multiple scenery," whereby two scenes are painted upon one canvas. Colored lights are thrown upon this drop-scene, which bring out certain colors while concealing others, so that with the same stage setting either a landscape or an interior may immediately be brought into view. Playing several acts with one set of scenery is an idea that should appeal strongly to producers, both as a novelty and from an economical point of view.

Revolutionizing the Orchestra.—Leo Sir, an aged violin-maker of Marmande, France, has perfected instruments that may revolutionize the orchestra. At present we use four violin-type instruments ranging from the soprano violin to the bass viol. M. Sir provides two super-sopranos, a mezzo-soprano slightly above the present alto, a barritone just below the tenor, and a sub-bass. The newly-organized orchestra has been tried out at the Montmartre Theater and critics declare that the possibilities of interpretation are wonderfully increased.

A Shrewd Scheme.—Missoula, Montana, has a wide-awake chamber of commerce. It decided that the mail-order catalog while highly diverting to the population also diverted much business from local firms. Why not destroy all the catalogs in town? Now Missoula has, too, a movie theater and a genius, name unknown. His plan was for the theater to advertise that mail-order catalogs would be accepted in lieu of the usual admission price, and prizes given for the oldest, the most used, and the newest catalogs. The scheme worked to a charm, and its success was celebrated by a bonfire fed by the Chicago publications. We should like to record that the mail-order houses came back with a retort as ingenious as the challenge, but the best thing they could think of was to complain to the Federal Trade Commission, alleging unfair practice "unreasonably burdening commerce."

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Inbreeding of Species.—In an experiment with 600 white rats belonging to the sixteenth to the twenty-fifth generations of brothers and sisters from the same litter, it was found, says *Science*, that close inbreeding produced no deterioration.

Sawdust as Stock-Food.—From an experiment station in Wisconsin comes the report that after a long-continued diet, consisting of one-fourth part of white-pine sawdust in their ration, cows showed no visible change in their weight or milk production.

Spiritualistic Mania.—From Southern Bavaria comes the report of an entire family of 11 members going insane through spiritualistic experiments. The neighbors found them, after destroying their furniture, about to offer up an infant as a sacrifice to the "spirit of pure light."

Turpentining the Pine.—Successive seasons of turpentining cause no lowering in strength or resin content of pine trees, states the Forest Products Laboratory of Wisconsin. The crude turpentine is the result of wound stimulus, and comes only from living cells in the sap wood region of the tap bore. The heart wood, which consists of dead cells, contains no sap.

Prehistoric Freight.—When the cargo of a ship was unloaded recently at Portland, Oregon, it was discovered that a certain portion, which was supposed to consist of walrus tusks, proved to be the ivory tusks of the mastodon. Crafty Siberian natives had substituted these for the walrus ivory which was ordered. The cheaters, however, cheated themselves, for in spite of its great age the substitute was well preserved, and the large size of the tusks consequently made them more valuable.

Crabs vs. Concrete.—In an effort to foil the shipworm, a wooden bridge crossing Boce Celga Bay, Fla., was replaced by one of concrete. Certain marine crabs, however, peculiar to that region, selected this bridge as their own, tunneling and boring into the adamantine material with ease. These crustaceans are known locally as stone crabs, and they are equipped with enormous, heavily armed claws. With the aid of these powerful tools they have succeeded in reducing portions of the concrete pilings to pulverized chalk.

The Fertile Aphis.—The report of the Smithsonian Institution just issued, gives an account of the hop aphis, in which the amazing fecundity of these minute insects is shown. According to the author, the mother aphis produces thirteen generations in a year. As each generation contains on an average of one hundred individuals, it was revealed that her progeny—barring destruction from the attacks of enemies and other natural causes—would number well into ten sextillion aphides annually.

Tree Growth.—With the aid of a newly designed denrograph, some remarkable features relating to the growth of trees was determined. These included such phenomena as actual daily shrinkage and expansion of trunk circumference, a restricted period of growth (not over three months' duration), and a non-rhythmic growth dependent solely on food supply, temperature and moisture. It was also found that the inchoate foliage and the elongation of branches may occur weeks before the trunks begin to enlarge.

Moths and Mimicry.—In some large quarries in Argentina it has been observed that a certain species of night-flying moths frequents these places during the day to rest. The moths lie flat against the rocks, which they match perfectly in color, and are practically invisible. This instance is peculiar by reason of the fact that these quarries contain a colored stone which is unknown elsewhere, and the further fact that it is less than a hundred years since the quarries were opened.

Ancient Bedfellows.—Although the ancestry of the bedbug appears to be unknown, it has been ascertained that its probable companionship with man began at a very early period. This probability is based largely on the habits of a closely related species which infects the nests of certain birds. It seems that along with man's evolution from a creature of arboreal habits to one of more refined tastes, the bedbug, on its part, lost no time in adapting itself to the changing conditions.

How Old Is Ann?—A belated report from the South African Museum states that a gigantic turtle captured in the year 1834 died at that place a few months ago. At the time this animal was captured it was full grown, and its death gave rise to much speculation as to the longevity of these creatures; for, as yet, nothing is definitely known about their natural term of life. When the turtle was acquired by the museum it was named Peter. One day Peter laid an egg. A hurried consultation of the museum principals took place. The result was a blushing decision to give Peter the effeminate but not inappropriate name of Ann.

Squirrels and Toadstools.—An English naturalist reports that squirrels are fond of fungoid plants. His observation of the animals in their natural haunts showed that they ate with evident relish the Fly Agaric, a mushroom deadly poisonous to man. It was noted, though, that they ate only the stalks of the plants, leaving the umbrella, or cap, untouched. This raises the question as to whether the factor of safety lies in the immunity of the animal or in the fact that the poisonous substance is concentrated in the rejected parts. If the latter be true, it reveals an interesting feature of the instinctive discrimination of these animals.

Corn with a Story.—A variety of corn grains was found in the mortuary urns of prehistoric graves, recently unearthed in Tennessee. The only other cereal of its kind—a type between true flint and popcorn—occurs in the West Indies. This is taken by the Bureau of Ethnology as proof of intercommunication between the ancient peoples of North America and those islands, if not evidence that within the time of man the West Indies were a continuous part of the North American mainland. As the locality in which these graves have been found becomes more fully searched, it is possible that other sustaining evidence in this connection will be found.

Sex Determination.—By starving male newts (Triton alpestris) at the time spermatogenesis is most active, it has been found that the animals remain in a neuter condition. Then, again, by feeding them plentifully throughout the winter, during which period these animals are neuters by nature, they were found to assume female coloration and other feminine characteristics in the following spring. The most curious transformation, however, was discovered when they were dissected. The fatty tissues of the reproductive organs contained an ovary and young ovocytes, such as would be found in a recently metamorphosed female, together with well-developed oviducts.

A New New Zealand.—The gradual disappearance of the native races of New Zealand, and the ever-increasing European population is not the only great change taking place in that antipodal country. As a result of the competition with imported species which have returned to a feral life, the lower animals are also fast giving ground. Nor is this change confined to the animal kingdom. More than eleven millions of trees of various kinds have been imported from the United States and elsewhere by reason of their superiority over the slow-growing native species; and these hardy forests of temperate origin bid fair, in time, to crowd out their sub-tropical rivals.

Longevity of Nutgrass Nuts.—There are tales of the sprouting of grass nuts that have been buried for 30 years. Government weed specialists believe they have an authentic case of such nuts being in the ground for eight years without losing their viability. To settle the question four galvanized-iron cans about two feet square and four feet deep, without bottoms, have been sunk into the soil at the Arlington farm near Washington, each can holding 250 pounds of soil well filled with the grass nuts, and each is covered against light. The cans will be opened, one by one, in 1923, 1926, 1931, and 1936, and if the nuts prove to be as tenacious of life as has been supposed, adequate means of extermination will be sought.

Civil Engineering Notes

A Motor-Boat Non-Stop Run of 6527 miles, which is said to be the longest on record, is reported by *Engineering* as having just been accomplished by the new Pacific Steam Navigation Company motor-boat "Lobos" of 9000 tons. Having left Liverpool on October 26th, the "Lobos" arrived at Bahia Blanca on November 20th, without once having stopped her engines.

Another Bascule Collapse is reported from Grays Harbor, Wash. The bridge, which had a span of 110 feet and a 16-foot roadway, was wrecked recently by rolling over backward. A new set of operating gear was being tested and was not handled very carefully. The pavement on the bridge was worn to such an extent that the counterweight was too heavy. While the bridge was being opened a gust of wind caught it and it was blown right over backward into the water.

A Valveless, Gearless Engine, intended ultimately for automobile use, is being brought to the bench-test stage in Manchester, England. In a very general way it may be said that the cylinders are so arranged, in multiples of three, that ports between them open and close in a fashion which permits each piston, on the return stroke of its two-stroke cycle, to compress its own charge and to drive a charge into the combustion chamber of the adjoining cylinder.

Indian Hydro Projects.—Eleven sites in the Travancore State have been examined with a view to hydroelectric undertakings, says *Engineering.* As regards the Kallar scheme, the proposal is to construct a masonry dam to impound water in a lake of four square miles, with a fall of nearly 1000 feet. The Government of Bengal has appointed an expert committee to carry out a hydroelectric survey of the province. The survey is to be confined in the first instance to the Hill Tippera area round Comilla and Chittagong.

Electrification in Spain.—A development recently put under way includes about 40 miles of single track line comprising a link between the mining region and the northern seaboard, through a mountainous region with many tunnels, considerable grades, and severe climate conditions. The locomotives will be arranged for regenerative braking, and will operate at 3000 volts. Their speed at continuous rating is to be 35 kilometers per hour. The contract has been awarded, and covers one of the largest European electrification operations now under way.

A New Water-Works Hazard.—Crawfish, according to the *Engineering News Record,* threatened to destroy a canal bank on the Cape Fear River, by tunneling into the bank and causing it to leak. Sheet piling did not cure the trouble, as the fish worked round the ends or beneath the piling, so rows of auger holes were made in the bank. The holes were filled with chloride of lime and small sticks of dynamite exploded in them. Other holes were charged in the same way with common salt and the fish were presumably exterminated, as the leaks stopped.

Carrier Current Control of trains on electric railroads is suggested as a present possibility by experiments and tests made recently at Schenectady. The demonstration was designed primarily to show the applicability of the system to the expediting of electric train operation. It was developed particularly to afford an effective means of communication between the head and rear ends of long freight trains. Experience on the St. Paul's electrified sections shows that it is also adapted to communicating ahead of trains stalled by a faulty block, and straightening out the tangle with a minimum of delay.

Shanghai Harbor.—The report of the International Board, which has been considering the question of the improvement of Shanghai harbor, recommends the dredging of a channel, 600 feet long and 30 feet deep, in the south channel of the Yangtze estuary; the elimination of the private ownership of wharves, the entire harbor being placed under the International Harbor Commission; the construction of public quays and moorings and also of a commercial dock of the open type and mail steamer accommodation. In this connection it is proposed to build immediately a 600-foot wharf and 2500 feet of berthing suitably equipped. The estimated expenditure on immediate requirements is 10,750,000 Shanghai taels.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

The Chicago Broadcasting Station, operated by the Westinghouse organization and known as KYW, is heard regularly at such distant points as Lutz, Fla., Austin, Texas, Woburn, Mass., as well as at other distant points. The normal radius of transmit is about 750 miles. The equipment is similar to that used by the Newark and Pittsburgh stations, operating on 360 meters wave length and using 500 watts.

Radio Equipment of Huge Airplane.—There has been installed on one of the huge "Goliath biplanes engaged in the Paris-London aerial service a combined radio telephone and telegraph equipment of 35 watts antenna output, with a sending range of about 180 miles at 900 meters' wave length. The complete radio equipment, according to *Radioelectricite*, weighs only 125 pounds. An air-propeller-driven generator for six volts and 700 volts and a 6-volt storage battery supply the necessary current. A 3-bulb amplifier is used for receiving on all wave lengths between 300 meters and 1000 meters.

British Vacuum Tubes.—Our British friends have evidently made up their mind not to fall behind in the matter of vacuum tubes. Thus their vacuum tube offerings range all the way from small receiving tubes to large tubes of 500-watt capacity. The latest tube, or valve, as they call them in England, is the Mullard ORA. The plate voltage of this tube is given as 30, and the filament voltage as 3.6 to 4 volts. The base of this tube is of the four-prong type. This tube is said to combine efficiently the qualities of a rectifier and an amplifier. Thus it becomes possible to carry only one tube in stock for all purposes.

The Brown Microphone Relay is a modification of the type used by the Royal Air Force and the Admiralty. It is enclosed in a polished teak case. On the radio side it has a resistance of 4000 ohms, and has a transformer mounted on a separate base with condenser, suitable for telephones of 120 ohms resistance. This is a highly efficient instrument, especially for the amplification of feeble signals, and enables the operator to dispense with the use of vacuum tube amplifiers. Whereas the current consumed with tube amplifiers is considerable, the current required for the microphone relay is minute, being approximately only 25 milliamperes supplied from a 6-volt dry battery.

The Amateur Transatlantic Tests.—Amateur operators sent radio messages from this country to Scotland during the recent past which were reported as strong and steady by the representative of the American Radio Relay League, which was in Scotland to receive the signals. The transmitting sets were limited to a rating of 1 kw. maximum and to a wave length of 200 meters. This is in contrast with the commercial transmitters rated at 100 kw. to 1000 kw., or over, using long wave lengths. According to reports received by the Radio Corporation of America, all of the successful senders employed vacuum tube transmitters. Nearly all the messages received in Scotland were sent from New England and New York State.

Loud-Speakers.—It is interesting to note how many devices are being introduced for service as loud-speakers in connection with the receiving of broadcasted music. One of the new devices is a simple horn provided with two arms that terminate in soft rubber caps. The ordinary pair of telephone receivers clamps right over the two arms, so that the sound must then pass up through and be amplified by the horn. Another device takes a single receiver, which is placed in the base. Several receivers are provided with special coupling members so that they may be fastened to the usual phonograph tone arm, for amplifying the sound. There can be no doubt that broadcasted music is at its best when it is heard through some form of loud-speaker.

Radio Telephony for Moving Trains.—France has recently been carrying out experiments on the Nord Railway with regard to the employment of radio telephony between moving trains and between a moving train and a fixed point. Radio antennæ were fixed on to a railway coach, and a compartment of the same coach was fitted as a transmitting and receiving station. Between two telegraph poles by the side of the line horizontal antennæ were fixed at a given point. As soon as the train left Paris a radio conversation was begun between the train and the radio station at the Gare du Nord, and was continued until the train left Creil, 34 miles distant. Without any modification of the wave length, the voice remained, it is stated, equally clear whatever the distance of the train from Paris, and whatever its speed, which was at times 50 miles an hour. Experiments are to be tried between Paris and Calais.

A Suggestion to Vacuum Tube Makers.—While there was nothing better, the usual vacuum tube was considered just about ideal for the general run of vacuum tube work. However, since special tubes have appeared on the market—or at least are supposed to be on the market, for it is almost impossible to obtain them at this writing—it now occurs to the usual radio enthusiast that the regular run of vacuum tubes consume too much filament current. Consider, for instance, a detector and two-stage amplifier. That makes three tubes. Each tube draws somewhat over one ampere, so that three tubes draw well over three amperes. Such a heavy current consumption renders quite out of the question the use of a dry battery. Then again, when a storage battery is used it has to be frequently recharged. In either event it seems to most of us that the current consumption is entirely too great. So it is indeed welcome news to learn of the new tubes coming along, which are going to operate on a single dry cell with a current consumption of one-quarter ampere. This is certainly a move in the right direction.

Reduction of Aerial Losses.—The difficulties to be overcome in raising the efficiency of high-frequency generating plants are apparent upon very little consideration, but even so, it will come as a surprise to many to learn that of the high-frequency energy generated and supplied to the aerial, as little as 10 per cent is radiated. There is an obvious field for investigation here, suggests *The Electrician*. In a recent paper by Mr. Eckersley, read before the Wireless Section of the Institution of Electrical Engineers, an account is given of work carried out in 1920 for the Marconi Company, in which the ground under the aerial was covered with a wire network and thus screened from the electrical field. As a result the losses were reduced four times. This is obviously a most important claim, and we can only regret that the discussion which took place, and which was maintained with a warmth that augurs well for the future of the Wireless Section, did not supply some of the omissions from which the paper suffers. It is of interest to know what is the precise effect upon the propagation of signals when no ground connection is used.

Radio vs. Audio Frequency Amplification.—More and more attention is being paid to radio frequency amplification, although audio frequency continues to predominate. The difference between these two methods is that radio frequency amplification consists of building up the intercepted radio energy before impressing it on the detector, which in turn makes this energy capable of actuating a telephone or other device. Audio frequency, on the other hand, is used to build up the audible frequency current issuing from the detector. Now, in that many types of detectors only begin to function when the intercepted wave strength has reached a critical point, it stands to reason that very weak waves will not be detected, and no amount of audio frequency amplification can help matters, since there is nothing to amplify. On the other hand, even with extremely weak signals it becomes possible to pass them through one or more radio-frequency amplifiers to be built up before being introduced to the detector. Then, if desired, the output of the detector can be passed through several stages of amplification, so as to obtain maximum audibility.

Mechanical Engineering Notes

The Chip Wringer.—Under this very clever designation there appears a centrifugal extractor designed to separate from metallic chips and shavings the oil which adheres so tenaciously to such material. After loading the separator with chips, a few turns of the basket, in one instance, pour out no less than six gallons of high grade oil ready for use. It is to be doubted whether chips from all sources would assay so high in oil, but they always carry some, and it should always be profitable to recover this material.

Small Coil Springs, according to *The Practical Engineer,* may be tempered in a wood-burning furnace, by being first exposed to the 'ame, and then quenched in a mixture of ten quarts rosin, twelve quarts tallow, and a barrel of fish oil. More tallow should be added if the springs break after tempering; but if the break is due only to brittleness and not to hardness, a six-inch ball of yellow beeswax should be added. The springs can be drawn to a reddish purple by being laid on a frame with horizontal radial arms mounted on a vertical rod. Held on this star-shaped contrivance, they should be lowered into a crucible of molten lead until drawn to the color desired.

Blow-Pipe Hazards.—That there is a fire-hazard connected with the blow-pipe is obvious, but the best precautions are not so plain. It is not the pipe itself, generally placed on a bench covered with a piece of sheet iron, that constitutes the danger, but rather the proximity of soldering fluxes and similar materials. Blow-pipes should be mounted on an iron table with a dished top, and this in turn should be mounted on a sheet-iron base or on flag stones. The table should be isolated from inflammable materials. It can conveniently carry a small vice and anvil, which is often useful in blow-pipe operations, especially in electrical shops where many soldered connections have to be made.

Machine Hammering with a "human stroke" is the interesting idea behind a recently developed rivetting hammer for small machine work. Instead of carrying the hammer in the more usual drop-head, the machine works "just like a man." The hammer head is at the end of a hickory helve, just like the hammer we used to use back on the farm. The handle end of this helve is fixed to a cam control; and it is claimed that "the adaptation of the elastic stroke, characteristic of the human arm and the old-fashioned hammer, has developed a resilient blow which coaxes metal into the desired shape with remarkable precision and speed—yet which kneads into the rivet stronger physical properties than have heretofore been possible." Also a speeding up of some 20 per cent is claimed for the average job.

New Uses for Rubber.—Among the many prize-winning suggestions brought out by the offer of the Rubber Growers' Association, the following are of interest: liquid rubber incorporated with paint or other composition for preservation of wood and metals against the action of the sea, and in the prevention of fouling of ships' bottoms. In paint for general decorative and preservative purposes. For automobile curtains, tops and mud-guards. The incorporation of rubber with cement for building purposes. The use of rubber as a heat-retaining covering for hot-water cisterns. For the construction of sea buoys and floats. In the construction of ship and wharf fenders. As filet for pattern making. As caps for the ends of ladders to prevent slipping. For rough-surfacing cement. For covering door handles. In composition with certain lubricants.

Automatic Electrode Feed.—There has recently been placed on the market a semi-automatic arc-welding lead, which may be attached to the standard automatic arc welder, retaining the continuous welding feature of the latter while permitting the operator to direct the arc as required by the conditions of the work. The new device consists of a welding tool to be held by the operator, which acts as a guide for the electrode wire. In the handle of this tool is provided a switch for operating the control on the panel of the automatic welder. Attached to the welding tool is a length of flexible steel tubing, with an adapter at the other end for attaching it to the automatic welding lead. By means of this attachment the operator can work on products where the seam to be welded is of very irregular contour, or on large jobs where the clamping and travel mechanism for full automatic welding could be complicated and costly.

Patents and Trade-Marks

General Principles. Current Comment, and Interesting Decisions

Trade-Mark "Cedar" Descriptive.—The Commissioner of Patents has recently decided that the word "Cedar" as a trade-mark for polish for hardwood floors, woodwork, furniture, etc., is descriptive (ex parte Channel Chemical Company, 293 O. G. 877). Incidental to this decision it was held that the use of the trade-marks "O-Cedar" and "Cedarine" did not constitute a trade-mark use of the word "Cedar," and that an applicant can not mutilate his mark to convert it into a descriptive mark and register it. It seems that the applicant attempting to register the word "Cedar" claims use thereof as early as 1886, basing this claim of use upon the actual use of the trade-mark "O-Cedar" since 1907, and the use of the trade-mark "Cedarine," which the applicant purchased in 1917, for dating back the alleged use of the word "Cedar" to 1886.

The Lampert Bill.—Not only those engaged in the practice of patent law will be glad to learn that the Lampert Bill, providing for an adequate increase in the salaries of the Patent Office personnel has finally been passed by the House of Representatives, but as well all to whom patents and patent rights and the proper protection of inventions are directly or indirectly of importance. The passage of this bill marks a distinct advance in the measures which have been undertaken to relieve the congested condition of the Patent Office, and it is to be hoped that the Senate will act promptly, and likewise pass the bill. The SCIENTIFIC AMERICAN does not hesitate to urge upon its readers to do everything possible to further the complete enactment of this law and to see that it receives favorable consideration at the hands of the members of the Senate.

Patent Assignment Must Be in Writing.—A patent right is an intangible right of property, which nevertheless can be transferred from one to another as can any other personal property, but the law has clearly defined what means are necessary to effect such a transfer. The United States District Court of Delaware has again pointed out (Mineral Separation, Ltd., et al, vs. Miami Copper Co., 275 F. 572), that under the Revised Statutes, Section 4898, an assignment of a patent may be made by a written instrument only, and though no particular form of words is essential, yet to constitute an assignment the instrument must be substantially a transfer, actual or constructive, with the clear intent at the time to part with the legal interest in whole or in part, in the thing transferred, and with full knowledge of the rights so transferred, and an instrument which does not purport to transfer any present interest in an existing patent or in one for which an application is pending is not an assignment within the Statute.

Application of Prior Art in Patent Suit.—Judge Anderson in writing the decision of the Circuit Court of Appeals of the First Circuit in a recent suit on the Eibel patent No. 845222 (Minnesota & Ontario Paper Company vs. Eibel Process Company, 274 F. 548) gave a most scholarly discussion of certain processes of the paper-making art, particularly those involving the use of Fourdrinier machines which for generations have been the best-known and most commonly used paper-making machines. In deciding that the Eibel patent was invalid and was not infringed, the Court reiterated the principle of patent law, that a patent on a mere difference in degree in the use of a principle shown in the prior art, is invalid. Furthermore, the court held that the principle of patent law by virtue of which a patentee is entitled to all the uses known and unknown of which his invention is capable, and gives to him the benefit of all the advantages of his invention which he did not discover, likewise applies to prior art uses and that in interpreting the prior art with a view to determining its bearing on the patent in suit, such prior art uses, although unknown at the time of the creation of the prior art patents, were pertinent.

Manufacturing Under Canadian Patents.—It is very important that Canadian patentees comply strictly with the provisions of the Canadian Patent Act with reference to the manufacture of patented inventions, for the general war extension of manufacturing time provided by the recent amendment expired on January 10th, 1922. In most cases it is advisable for patentees, on the issue of their Canadian patents, to consider the matter of having their patents ordered subject to the grant of licenses. When a Canadian patent is not ordered subject to the grant of licenses, the manufacture in Canada should be commenced within two years of the grant of the Canadian patent, unless an extension of manufacturing time is secured before the expiration of the said two years. Extensions of manufacturing time can be secured in such cases only where, in an affidavit, the patentee is able to set forth facts which will show that it would be an unusual hardship to compel him to manufacture within the two years. In cases where a Canadian patent is ordered subject to the grant of licenses, the patentee is not required to manufacture in Canada within a stated time in order to preserve his rights. Of course, should a license be granted the patentee will receive a reasonable royalty.

Assignability of Trade-Marks. — A trade-mark can not be assigned or its use licensed except as an incident to a transfer of the business or property in connection with which it has been used. This is likewise true of a registered trade-mark, and Section 10 of the Trade-Mark Laws specifically so provides. The courts have repeatedly affirmed the correctness of the foregoing doctrine. In Dietz vs. Horton, 170 F. 865, it was held that a trade-mark can not be assigned except as incident to the sale of the business and good will in connection with which it has been used or as an incident to the sale of the premises where the article has been made and has acquired a special reputation in connection with such place. In Bulte vs. Igleheart Bros., 137 F. 492, the court said: "A trade-mark is analogous to the good will of a business. Whoever heard of a good will being sold to one, while the original owner continues the business as before? The good will is inseparable from the business itself. So likewise is a trade-mark or a trade-name that gives assurance to a purchaser that the article upon which is stamped the trade-mark or tradename is the genuine production of the manufacturer to whom the trade-name or trademark points by association as the maker of the article. Therefore it is that it is a necessary qualification to the assignability of a trade-mark that there goes with it the transfer of the business and good will of the owner of the symbol."

Names of Patented Articles.—Upon the expiration of a patent on an article of merchandise any trade-mark or trade-name that has been associated with the article in the sale thereof during the life of the patent becomes public property. This doctrine is clearly expressed in Singer Mfg. Co. vs. June Mfg. Co., 163 U. S. 169, where the Court, speaking by Mr. Justice White, said: "The result, then, of the American, the English and the French doctrine universally upheld is this, that where during the life of a monopoly created by a patent, a name, whether it be arbitrary or be that of the inventor, has become by his consent, either expressed or tacit, the identifying and generic name of the thing patented, this name passes to the public with the cessation of the monopoly which the patent created. Where another avails himself of this public dedication to make the machine and use the generic designation, he can do so in all forms with the fullest liberty, by affixing such name to the machines, by referring to it in advertisements, and by other means, subject, however, to the condition that the name must be so used as not to deprive others of their rights or to deceive the public, and, therefore, that the name must be accompanied with such indications that the thing manufactured is the work of the one making it, as will unmistakably inform the public of that fact." The doctrine of the above-quoted Singer case has been repeatedly upheld in subsequent decision bearing on this question.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Using a Monkey Wrench to Connect Electric Cables.—Instead of solder, the modern tendency with regard to electric cable connections is to use a monkey wrench. In other words, special connectors are being used which grip the cable ends firmly yet require only the application of a monkey wrench. Thus in a certain bit of work the old method would take two hours, while with the new connectors the cables can be connected in 15 minutes.

Awards of Potts and Cresson Medals.—The Franklin Institute, Philadelphia, acting through its Committee on Science and the Arts, recently awarded its Elliot Cresson gold medal to Dr. Byron E. Eldred of New York City for his low expansion leading-in wire for incandescent lamps. At the same meeting the Institute awarded to Alfred O. Tate of Cranston, R. I., its Howard N. Potts gold medal for his electrolytic process and waterproofing textile fabrics.

The Morris Liebman Prize, the cash award made each year by the Institute of Radio Engineers to that member of the Institute who is considered to have made the most important contribution to radio art during the preceding twelve months, has been awarded to R. H. Heising of the engineering laboratory of the Western Electric Company "for his analysis of vacuum tube action and his research work on modulation systems."

Edison Medal for 1921.—In recognition of his work in demonstrating that it was possible to transmit an electric current of 1,000,000 volts, the American Institute of Electrical Engineers has awarded the Edison Medal for 1921 to Cummings C. Chesney, manager of the Pittsfield works of the General Electric Company. Under Mr. Chesney's direction electrical engineers developed the first revolving field type alternators installed in systems using 40,000 to 60,000 volts. He also developed commercial apparatus for service up to 220,000 volts, culminating in the last successful transmission of 1,000,000 volts.

Electric Conversion of Fodder.—A large Swiss company has acquired the patents of a new method to conserve vegetable fodder in silos. At the bottom of the silo is placed a large metallic electrode, upon which freshly cut grass, clover, corn, beet leaves, etc., are piled to the desired height, a metallic cover serving as upper electrode. Between these two electrodes a low-voltage alternating current of from 200 volts to 500 volts is applied for a few days or nights, which kills all bacteria either directly by the current or by the developed heat. The conservation of 10 tons of fodder requires between 130 kilowatt hours and 200 kilowatt hours. Several years of actual trial have proved this method to be far superior to any other means of keeping fodder in silos without previous drying.

The Small Power Plant for the Village.—According to *Electrical Review*, there are 125,929 towns and villages in the United States having a population under 1000 inhabitants. A large proportion of these communities are entirely without electric service and without prospects that central stations will be extended to give them service. To the end of overcoming this condition, an American machinery manufacturer has designed two standard sizes of 110-volt gasoline-engine driven generating plants complete, rated at 5 kilowatts and 15 kilowatts, respectively. The 15-kilowatt unit, supplemented by batteries, will successfully serve up to 50 average village buildings, including stores, churches, garages, etc. The sets are self-contained and consist of four-cylinder four-cycle engines directed connected to generators mounted on rugged cast-iron base plates.

A Vacuum Set for Panama.—There has been installed at Almirante, Panama, a 2-kw. radio tube transmitter. The set consists essentially of equipment designed to supply direct current at 12,000 volts for the plate supply of the radiotron tubes, and for converting this power into radio frequency. Power is supplied to the transmitter at 440 volts, single phase, 60 cycles, and stepped up to high voltage by means of a transformer, the output of which is fed into the rectifying system. The rectifying system consists of two kw. kenetron tubes which supply 12,500 volts direct current to the plate circuits of the radiotron generators. The radio frequency power is generated by a system consisting of two 1-kw. radiotrons with the necessary grid and plate coils, together with an antenna loading coil. While it can not be predicted exactly what the range of this set will be, it is expected that it will equal if not exceed the range of a 50-kw. spark transmitter. As an example of its initial effectiveness, the set is now carrying on reliable and most satisfactory communication from Almirante, Panama, to New Orleans, La., not only at night but during the daylight period as well.

How the Submarine Cable Acts.—A number of interesting conclusions are drawn from the study of submarine cable transmission made by John R. Carson and J. J. Gilbert and reported by them in the *Journal* of the Franklin Institute. The general conclusions are as follows: (1) Contrary to usual assumption, the "sea-return" impedance is by no means negligible; (2) the armor wires which surround the cable and which are necessary for mechanical protection have a very pronounced effect on the impedance of the sea return and even at moderate frequencies may become the controlling factor; (3) the rapid increase in the impedance of the armor wires with frequency and their pronounced and even controlling effect on transmission make a thorough-going study of their role in the electric system a matter of first-class importance; (4) at relatively high frequencies the return impedance, and hence the attenuation and distortion, may be very greatly decreased by a correctly designed thin metallic sheath concentric with and in electrical contact with the armor wires.

Harnessing Wind Power.—A new attempt to make use of the winds has now appeared in the form of a combined windmill, generator and storage battery outfit, designed to transform the energy of all winds into electrical energy, store it in the storage battery, and have it transformed into useful work about the farm as required. A 1-kilowatt generator is mounted on the main casting at the top of the tower and geared directly to the shaft of a 14-foot steel wind wheel. The gear bearings are mounted on roller bearings. The entire reduction gearing runs in an oil bath. This generator, which is of the 32-volt type, is a compound machine, differentially wound and gives a constant voltage characteristic over a speed variation ranging from 750 to 2500 r.p.m. The armature is carried on ball bearings which are packed in grease and will operate for one year without attention. The storage battery is of the 32-volt type with a capacity of 280 ampere-hours. It is estimated that this is sufficient to operate the lights on an average farm for eleven successive days without recharging. The battery can be charged at wind velocities varying from 8 to 30 miles per hour.

A High-Speed Monorail System.—Between the twin cities of Barmen and Elberfeld in Germany there has been in successful operation for about 20 years a monorail overhead trolley system traveling at the rather high average speed of 20 miles an hour, according to *Electrical World*. The author of a somewhat visionary paper under notice gives a very elaborate and detailed description of a similar monorail road, capable of traveling 200 miles an hour, and intended to connect Paris with Nice, a distance of 600 miles, to be traversed in three hours. Instead of using a solid girder construction to support the single running rail, Mr. Mahl has chosen a rail held by a catenary cable suspension system. There is one driving wheel provided for each yard of length of the vehicle. Each of these driving wheels has an inbuilt gearless 40-kw. motor weighing about 1200 pounds. The complete car would weigh about 2800 pounds per yard, including passengers. To increase the adhesion of the wheels a magnetizing winding is embedded in the outer part of the wheels. Steel towers, weighing each about 15,000 pounds, are supposed to be erected every 50 yards on the level and every 30 yards on grades. Six steel cables two inches in diameter support the rail.

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscription, books, etc. This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14392) J. P. D. asks how to "spot" tobacco leaf. A. We thought that there was no demand for a spotted leaf which was once so popular, but this may answer: Finely powdered ammonium carbonate, 2 av. oz.; solution of hydrogen peroxide, 16 fl. oz. Place the ammonium carbonate in a shallow dish, and pour upon it the hydrogen peroxide solution; effect a solution of the salt by stirring, and by the use of a small whisk-broom scatter the mixture upon the lead, and let dry. Care must be taken that the hydrogen peroxide solution is of full strength.

(14393) H. B. says: I wish to prepare blue roses and preserve them as long as possible. You published a formula a number of years ago. A. We did. The SCIENTIFIC AMERICAN published a recipe for blue roses which are simply white roses whose stems have been submerged in the following solution: Water, 100 c.c.; aniline methyline dye, 2 grams; potassium nitrate, 2 grams. This color scheme, representing a little less than ½ pt. of water and a little over ½ oz. each of aniline dye and saltpeter, is worth trying for the sake of novelty. You can preserve them by any one of the following formulas for a longer time than usual: The usual method of preserving cut flowers in a condition of freshness is to dissolve small amounts of ammonium chloride, potassium nitrate, sodium carbonate or camphor in the water into which the stems are inserted. The presence of one or the other of these drugs keeps the flowers from losing their turgidity, by stimulating the cells to action and by opposing germ growth. Flowers that have already wilted are said to quickly revive if the stems are inserted in a weak camphor water. Dr. Dixon states that tincture of nux vomica added to the water in which cut flowers are kept exercises a stimulant effect upon the flowers. The chrysanthemums on which he tried it held their freshness for an unusually long time.

(14394) J. B. C. asks for a formula for a good whitewash. A. There is none better than what is known as "Government whitewash." It is, or was, used by the U. S. Government for painting lighthouses, and it effectually prevents moisture from striking through: Take of fresh Rosendale, or other good cement, 3 parts, and of clean, fine sand, 1 part; mix with fresh water thoroughly. This gives a gray or granite color, dark or light, according to the color of the cement. If brick color is desired, add enough Venetian red to the mixture to produce the color. If a very light color is desired, lime may be used with the cement and sand. Care must be taken to have all the ingredients well mixed together. In applying the wash, the wall must be wet with clean fresh water; then follow immediately with the cement wash. This prevents the bricks from absorbing the water from the wash too rapidly, and gives time for the cement to set. The wash must be well stirred during the application. The mixture is to be made as thick as can be applied conveniently with a whitewash brush. It is admirably suited for brickwork, fences, etc., but it can not be used to advantage over paint whitewash.

(14395) E. P. P. says: I occasionally want to make scented fish bait, prepared bait is so expensive. A. For moistening the bat, we need, according to the *Pharmazeutische Rundschau*, the following preparations: (1) Peruvian balsam, 1; oil of mirbane (nitrobenzol), 1; anhydrous alcohol, 4. (2) Musk, .05; civet, .25; Peruvian balsam, 4; oil of aniseed, 1.5. (3) Extract of fresh "broad bean" leaves, 10 to 150, mixed with 10 of nitric ether, and 1 drop of volatile animal oil. (4) Especially for trout: civet with redwood oil.

(14396) A. D. W. says: Can you give me some of the principal dates connected with the crossing of the Alps by various means of transportation? A. The Alps were crossed by Hannibal, 217 B. C.; by Domans, 154 B. C.; by Napoleon, May, 1800. Mont Cenis tunnel through the Alps commenced 1857, completed Dec. 25, 1870. St. Gothard tunnel commenced 1872, completed Feb. 29, 1880. Simplon tunnel completed Feb. 24, 1905. First flight by aeronaut over the Alps, September, 1910.

(14397) P. W. R. asks how the inflammability of benzine can be reduced. A. Brodtmann says that he prepared mixtures of benzine and carbon tetrachloride in various proportions of volume, and found that a mixture of 7 volumes of tetrachloride and 3 volumes of benzine was still inflammable upon the approach of a match. The liquid burned with a strongly shooting flame under development of hydrochloric acid fumes. Only when the proportion reached that of 9 parts of tetrachloride to 1 part of benzine did the liquid require heating to inflame, but the flame soon became extinguished by itself. Benzine can be gelatinized as follows: Boiling water, 4 oz.; cocoanut-oil soap, 4 dr. Dissolve, and when cool add ether and ammonia water, each 2 dr.; glycerine, 1 dr. Mix the two solutions, and to 10 drops of the mixture in a bottle add about ½ dr. of benzine, and shake until it gelatinizes. More benzine is gradually added, with constant shaking, until the mixture soon assumes the appearance of boiled starch.

(14398) A. W. P. asks: Can you tell me what metal or substance is the clearest conductor of sound? For example, what metal or substance will, if tapped or struck sharply on one end (assuming it to be in the form of a rod) reproduce the sound most clearly on the opposite extremity? A. Probably aluminum is the most sonorous metal, and will reproduce the tone most clearly when a bar is struck on one end. It will vibrate for a long time and gives a very beautiful tone. Perhaps silver would be a close second to aluminum in this respect.

(14399) R. S. J. asks: Can you furnish me a formula for determining the relative humidity in per cent, as taken from the dry and wet bulb thermometers? We have in our plant a humidity dryer equipped with these instruments, but have no means of checking the relative humidity. For instance, if the wet bulb reads 90, and the dry bulb 130 degrees Fahrenheit, what formula would be used to determine the humidity? A. You will find in the Smithsonian Meteorological Tables, Fourth Revised Edition, 1918, the instructions on pages lvii-lx the reduction of observations of the Psychrometer, or wet and dry bulb thermometers, but the accompanying tables, pages 171-185, do not carry the air temperature, dry bulb, above 120 degrees Fahrenheit, which is sufficient for the work of the Weather Bureau but not for your drying room. We would suggest a reference to the Bureau of Standards, Washington, D. C., for additional data. The formulas are quite complicated. You will first find the dew point and then the relative humidity by the methods indicated. Poynting and Thomson's Physics, volume, Heat, page 211, at bottom, has this statement, "At the best the instrument is not very exact. Its indications vary with its situation and the exposure to the wind, and it is best to use a simple formula and be content with an approximation to the truth." Following this advice you might apply to the Weather Bureau for Tables of Dew Point and Relative Humidity, which will answer the purpose and be as nearly correct as those which are employed by the Bureau in its work. Poynting and Thomson, as quoted above, give a simple formula, but all formulas require tables for obtaining vapor tensions and dew points at all temperatures, and some require also the barometer reading, so that without tables the humidity is not determined. For this reason a table giving dew point and relative humidity direct is the best way of obtaining the humidity.

Winged Surveyors

(*Continued from page 160*)

to the wind; for a round trip, when the air blows from any direction, takes longer than in still air.

Next comes the job of developing. The negative turns out all right. As each length is fixed it is put in a stationary tub and water kept running therein.

The next day each negative is numbered; the negatives are cut apart and each is put in a numbered envelope. We make a print of each negative, being careful to get them the same tone as nearly as possible. More than one print from the same negative is required to keep this even tone.

The biggest part of the job remains, the assembling of the mosaic. The mosaic if assembled as a whole would be about 50x90 inches, which would be rather unhandy to handle and copy, for we plan to copy it photographically on large-sized negatives, 20x24 inches. We therefore plan to make the mosaic in two sections, the adjoining sides of each section extending some three inches into the area covered by the other sections. This means some additional prints.

First, the area covered by each negative is plotted on the Geological map and the plotted rectangle given the same number as the negative. We have obtained data from surveys and large scale to give us the distances between some 12 points and their locations that can be identified on the photographs. These are for our control and will increase the accuracy of the mosaic.

A piece of compo board about 4x5 feet is put on the top of a table and on this compo board are located the control plants that lie in the section. Distances are laid out at the average scale of the photographs. For example, we place the photographs lying between points 1 and 2, the picture of 1 directly over the plotted position of 1. Then trimming and matching the pictures as closely as possible, we find that the picture of number 2 is ¼ inch short of the plotted number 2. The distance is about 2½ miles, or about 15 inches at the scale of 1/10000. This seems fair enough, for we believe that when wet with the stickum stuff, this ¼ inch can be obtained. If the distance is beyond the stretchability of the prints, we can adjust this difference by distributing that ¼ inch in the five or six intervening overlaps. But it is surprising how such errors can be adjusted by stretching and contracting the dampened prints. Nearly three weeks are required in making this assembly of prints and our bird's-eye view is complete.

We had built a special 20x24 camera with a glass back against which 20x24 cut film could be pressed that could be used to copy. We, of course, could copy to various scales, but at first wanted only 1/10000 for the whole island. So our mosaics were carried to the camera and photographed. It required 11 exposures. So now to assemble a mosaic of Staten Island, we need only to paste down 10 prints, and that is lots easier than pasting down 170 prints; a sort of quantity results, you see.

Now what have we?

It is a mosaic of Staten Island; an aerial survey. It contains detail that no old-fashioned survey can record. Even individual trees and bushes. Taking the pains we have taken in the photographing and assembly, we find by checking against some 20 known distances that it is safe in feeling sure that the scale does not vary more than one per cent from that stated as being the scale.

It is a picture of Staten Island; very good to look at, too. And so much to be seen. The more you look the more you see. When you first look at a vertical photograph, of course it interests you because it is something different and strange. After looking at this mosaic for months, working over it for weeks and used to looking at vertical photographs, something new is always being found. Mrs. Smith's washing can be seen hanging on the line, so you know Mrs. Smith's wash day even if you don't know Mrs. Smith.

Interpretation of vertical photographs is a new art. During the war the French had perhaps a half dozen men who were rated as supreme in this sort of work. And it is a safe bet that they are still finding things they never saw before. Development of aerial photography is now an educational campaign.

People must learn to interpret such pictures to learn the use to themselves in their own special line of work. Railroad men, municipal authorities, engineers and lumbermen will all have specialists who have become expert in seeing what they want to learn in a vertical aerial photograph.

Radio for Everybody

(Continued from page 168)

other station is to be installed in St. Paul, another in Oklahoma City, another in Denver. Then there are stations which operate more or less regularly, scattered throughout the country. Among these is 2XK, in New York City, operated by Lawrence Cockaday; 2XP, operated by Louis G. Pacent at Winfield, Long Island; 8XK, operated by Frank Conrad at Pittsburgh, Pa., and a score of others. Union College, at Schenectady, N. Y., is also operating a radio-phone transmitter. The Western Electric Company has been operating a radio-phone transmitter off and on at its laboratory in New York City. During one of the tests a 500-watt transmitter was employed, yet the steamer "Col. E. E. Drake" intercepted the radio-phone conversation at a point 1000 miles west of San Francisco—something like a distance of 4000 miles. The usual wave length of the Western Electric radio-phone transmitter is 450 meters.

Various colleges and other institutions have inaugurated radio-phone services. Typical of this class of broadcasting stations is the University of Wisconsin. The physics department of the University has installed a radio telephone transmitter which covers a distance of 60 miles in broad daylight, and many times that distance at night and under ideal conditions. We might add here that radio waves carry farther at night than during the day, and better in winter than in summer. The University is supplying a complete radio-phone service made up of weather forecasts, market reports, concerts, news, and so on, and is even going one step further by supplying all the necessary information and data for the construction of receiving equipment. A special code has been arranged, together with special mimeographed forms, so that the farmer, following the radio-phone reports, can jot down the information in certain places on the mimeographed form and in that manner considerable time is saved. Thus when the farmer hears "AC," the section marked "AC" on his mimeographed form informs him that the figures called off stand for "Hogs: Estimated receipts for today." And so it goes.

At the Other End of the Invisible Line

Appreciating the real value of radio broadcasting, the leaders in many different lines of endeavor have and are freely giving their services evening after evening. The greatest singers are going before the radio transmitter, in order that they may entertain tens of thousands of listeners. Our men of letters and the Nation's leaders are speaking to radio audiences. The clergy have taken kindly to the radio broadcasting idea, realizing that it is easier to preach to many a man and his family in the home than to expect them to come to church. Candidates for public office have not been slow to make full use of the radio telephone, for it is so much more genteel than touring the territory and delivering a series of stump speeches. There is no end to what broadcasting can do for the public—and for the man at the transmitting end.

We can view the present without difficulty; but when it comes to predicting the future of broadcasting, we must move rather cautiously. The radio telephone, in its present form, is by no means perfect, although it compares favorably with the usual phonograph. In fact, by using a loud-speaking telephone in conjunction with a receiving set that includes a two-step amplifier, the music and talks can be heard in a large room with greater clearness and with less metallic or foreign sounds than the usual run of talking machines. And the cost, please bear in mind, is about the same as that of a corresponding phonograph. The operating expense, it goes without saying, is practically nil, since no records are required for the radio set. Occasionally the storage battery which operates the filaments of the vacuum tubes must be recharged, a matter of 50 cents or so; and a high-voltage battery, known as the "B" battery, employed in connection with the vacuum tube circuits, must occasionally be replaced at a cost of a few dollars. Then the vacuum tubes, which last from 600 to 1000 hours, must occasionally be renewed. But even with all that, the maintenance cost is trifling alongside the cost of buying new records for the usual phonograph. Still, the phonograph is by no means replaced, for it serves a very definite function in the home. It affords the elements of choice, to be sure, whereas the radio-phone service is fixed and cannot be changed by its audience.

We are pioneering in radio broadcasting, that is certain. It must only be a matter of a few years when this novelty of today will have found its logical place in the practical workaday world. Radio engineers are cautious individuals, as we might well expect them to be. Who wouldn't be cautious, when the sputtering, uncertain, balky arc generator of yesterday's radio telephone suddenly became the simple, silent, steady and highly practical vacuum tube radio telephone transmitter of today? It was the realization of the impossible; a dream come true.

Yet certain radio engineers do not hesitate to say that broadcasting is going to develop along broad lines, and that in the very near future it will become part of our regular telephone system. The day is not far distant when there will be broadcasting stations throughout the country so as to cover every square mile by radio-phone service, and arrangements will be made so that anyone, paying the proper toll charge, will be connected with any desired broadcasting station. The advertising manager of a department store will give out a list of the day's bargains by telephoning from his desk to the nearest broadcasting station, where his voice will be automatically transferred to the radio-phone transmitting apparatus for broadcasting. Government proclamations will be sent out by radio telephone, and confirmed by the printed word. The police department will send out lists of stolen automobiles, descriptions of criminals, and other information by radio. Even now certain police departments are planning to use the radio telephone for keeping in touch with their patrolmen.

Much remains to be done and too much care can not be spent in making broadcasting safe for the future. It must be kept in good hands, lest too many broadcasting stations get to work and only mess up each other's jobs and perhaps those of the Government and commercial radio telegraph stations. There is a definitely restricted number of available wave lengths in the "band" of wave lengths which has been set aside by international agreement for such work. The radio broadcasting service must not be burdened with too much advertising or propaganda matter, for that would also tend to weaken its attraction to the multitude. And the quality of the transmission, as excellent as it is, must be bettered, while the receiving sets must be steadily improved upon so as to make them particularly excellent for radio telephone reception.

If these various things are observed and carried out, radio broadcasting must continue to develop with virtually no limit in sight.

The Human Atmosphere

(Continued from page 200)

effects of the different forces upon the aura, complementary colored bands, etc. The evidence which he adduces put this curious phenomenon well this side of the borderland between science and quackery.

It is interesting to note that an aura showing a decided color, such as yellow, does not necessarily become green when viewed through a blue screen, as one would suppose, but may appear as purple or some other color, showing that colors of the aura probably belong to another and higher spectrum than that which we ordinarily perceive.

Sometimes two colors will appear to the observer combined, such as blue and yellow, which appear not as green nor as separate patches of blue and yellow, the color sensations being delivered to the brain simultaneously as blue and yellow. The effect is naturally bizarre.

Tests for Blotting Paper

BLOTTING paper is a very important article in any office; and where large quantities of it are bought, it is essential that some standard method be used for determining whether the paper which is to be purchased is suitable for the purpose intended. Such large quantities are purchased by the Government that it seemed desirable a short time ago for the Bureau of Standards to thoroughly investigate the subject and see whether the tests commonly used in determining the quality of blotting paper were as satisfactory as they should be. As a result of this work, it was found that many of the tests were not successful in showing up those qualities in the paper which are desirable or otherwise. The tests finally recommended approximate as closely as possible the service for which the paper is actually used, and it is believed that a better quality of blotting paper will be secured as a result.

Snow on the Mountain Makes Power in the Valley

When everything that will burn—the coal and the wood, the oil and the gas—has been consumed, and the energy so released has been dissipated, there will still remain for mankind an inexhaustible source of power in the endless cycle of moisture moving from cloud to mountain-top in snow or rain, thence to the valleys in little streams and great rivers, and so, finally, back again in vapor to the clouds.

And this potential energy, utilized to do such a simple thing as the turning of wheels, will provide the people with ample supplies of light and heat and power for all their needs.

It is a wonderful thing, this matter of the translation of raw energy into a form that is useful and convenient and economical; and it is worthy of the thought and study of every good mind.

Westinghouse has for years given the best of its research and engineering talent to the development of the great possibilities that are even yet only dimly seen by gifted men who have studied no other question for years. The subject of the most efficient types of apparatus for converting the power of the flowing waters into electrical energy; the question of the best methods of transporting this energy to its thousands of points of application; the problem of the many needs this distributed energy can meet and how best to meet them; these are just a few of the many things that must be progressively settled, and settled wisely, by the great industry of which Westinghouse is a part.

Even in the relatively few years that have passed since Westinghouse furnished the equipment that turns a tiny bit of Niagara's might into channels of usefulness for thousands, great steps forward have been made in electrical progress. Yet so young is electrical science that its possibilities for service and usefulness are still unlimited.

Employed today in the public service, in industry, and in homes, as a manufacturer and distributor of electrical and mechanical apparatus necessary for convenience, for economy and for progress, Westinghouse tomorrow will be the supplier of equipment that will be necessary for life itself.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

Offices in all Principal Cities · Representatives Everywhere

W WESTINGHOUSE ELECTRIC

Westinghouse

POWER PLANT AND LINE EQUIPMENT

Printed in the United States, by ANDREW H. KELLOGG CO.

VICTOR IMMORTALS

The Victrola has transformed
their art into a living reality
that will endure for all time.

"HIS MASTER'S VOICE"
REG. U.S. PAT. OFF.

This trademark and the trademarked word "Victrola" identify all our products. Look under the lid! Look on the label!
VICTOR TALKING MACHINE CO., Camden, N.J.

Victrola

REG. U.S. PAT. OFF.

Victor Talking Machine Co.
Camden, N. J.